REST AREA STUDY

GREAT FALLS TO SWEETGRASS

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PRECONSTRUCTION DIVISION

STATE HIGHWAY COMMISSION

HELENA, MONTANA

JULY, 1970

S. H. Comm.—Form 4 A

INTER-DEPARTMENTAL MEMORANDUM

STATE HIGHWAY COMMISSION OF MONTANA

To Grover O. Powers, P.E., Preconstruction Eng. Date July 21, 1970

From S.C. Kologi, P.E., Regional Engineer, West Subject: Rest Area Study Great Falls-Sweetgrass

Attached is a copy of the Great Falls to Sweetgrass Reat Area Study Report. Other copies are being distributed as shown below. This is to obtain comments prior to our requesting Bureau approval.

As you will note, we are proposing three new rest areas and the completion of the rest area north of Shelby.

The Power Rest Area is located approximately three miles south of Power. This rest area would have a cistern and chemical toilets since water is not available. The construction of this rest area would have to be accomplished under a separate contract since it cannot be developed in time to be let with project I-15-5(11) Vaughn North.

The Teton River Rest Area is located near the Teton River and is a natural rest area site. It is proposed to develop this as two rest areas rather than the one site as originally proposed. Although drilling for water has not been authorized at present, it appears as though a good water source can be developed. This rest area is being developed under project I-15-6(2) Teton River North and South.

The Marias River Rest Area is located near the Marias River and is another natural rest area site. A suitable supply of water has been found as noted in the report. The construction of this rest area would have to be accomplished under a separate contract as it cannot be developed in time to be let with project I-15-8(5) Toole County Line North.

The Shelby Rest Area is located approximately eight miles north of Shelby. This rest area was graded when the first two lanes of interstate was constructed. It is proposed to use a cistern and chemical toilets at this site because an adequate water supply is not available. It is also proposed to construct a facility similar to the Tra-Vel facility in Great Falls. This would serve in orienting the tourists coming from Canada prior to the U.S. 2 junction at Shelby. This project could be included in project I-15-8(19) Shelby-Oilmont Jct. which is scheduled to be let to contract in February, 1972.

(con't)

If no written comments are received by August 14, 1970, we will request Bureau approval based on the attached report.

32-SCK:EHL:sm

Attachment

cc: J.R. Beckert w/attach
B.B. Briscoe w/attach
C.A. McGiffin w/attach
R.W. Freeman w/attach
L.B. Fox w/attach
D.D. Gruel w/attach
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Stephen C. Kologi

Steve C. Kologi, P.E.,
Regional Engineer, West

INDEX

I. CISTERNS

I. CISTERNS

Cisterns can be used to satisfactorily store water if the proper procedures in location, construction and operation are followed. These procedures are outlined in Circular No. 17, CISTERNS FOR WATER SUPPLIES, which was written by the Montana State Board of Health Division of Environmental Sanitation. See page 34 of this report for details.

The size of a cistern is determined by the amount of water required per day and the length of time between fillings. For this report, a twenty year projected traffic count of 2625 VPD will be used. This figure is taken from project I-15-6(3) Power N. & S.

Water requirements for a typical rest area are based on Mr. G.M. Williams Circular Memorandum pertaining to the "Preliminary Design Guide for rural Interstate Safety Rest Areas with Comfort Stations" and a report by R.L. Johnson, Engineering Research Institute Iowa

(con't)

State University. See pages 18 to 33 for details.

First it is assumed that the cistern will hold enough water for all fixtures. The number of vehicles per day stopping at a rest area is 2625x 0.6 x 0.09=142. Assuming 10 gallons of water is required per vehicle, 142 x 10= 1420 gallons of water is required per day. Assuming the cistern would be filled once a week, (1420 x 7=9940 gallons), a 10,000 gallon cistern is required.

At the present time, the Shelby Weigh Station utilizes a 2000 gallon cistern for restrooms. It costs $20/1000 gallons to fill the cistern. Using this as a basis, it would cost $200 per week or $200 x 52=$10,400 per year to use a 10,000 gallon cistern.

The above figures are based on a 20 year projected traffic count and year round use. Since rest areas have the most use during tourist season which is about 5 mohths, a more realistic yearly cost would be in the neighborhood of $5000.

Next it is assumed that the cistern water will be used for lavatories and drinking. It is estimated

that 5 gallons per vehicle is required or 710 gallons per day. Again it is assumed that the cistern will be filled once a week which will require a 5000 gallon cistern.

The cost for filling this cistern, assuming year round maximum use, will be $100 per week or $5200 per year. Again, this is not a realistic figure because the maximum use would last about 5 months of the year. It is therefore estimated that the yearly cost would be in the neighborhood of $2600.

II. CHEMICAL TOILETS

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Chemical toilets have been successfully used in recreation areas. The larger units have a 1000-use cycle. They require 12 gallons of water mixed with a chemical to recharge for another 1000-use cycle. Each unit requires a source of electrical power from either a 12-volt battery or 110-volt a.c. For more information see pages 42 to 49 .

Based on a 1000-use cycle and 142 VPD stopping at a rest area (see page 2 for traffic calculations), the number of days between recharging can be calculated. It is assumed that each vehicle will average 3 people, therefore 426 people will use the rest area daily. Assuming the chemical toilets will be used 426 times per day, it will have to be recharged every 2¼ days.

Each unit has a 62 gallon storage capacity which will hold approximately 1000 usages. This storage tank would also have to be flushed every 2¼ days.

These units can be discharged into larger holding tanks that can be pumped once a year. If a large tank

was used in this case and pumped once a year, it would require a 10,000 gal. tank would have to be provided. This is based on maximum year round usage where as the maximum, or 426 people a day, will last approximately 5 months. At this rate a smaller tank could be used and be pumped once a year.

More research would have to be made as to the construction of the holding tank and pumping procedures. It is assumed that a concrete tank similar to a septic tank could be constructed to provide a positive odor and pollution control.

III. PROPOSED REST AREA SITES

III. PROPOSED REST AREAS

The proposed rest areas were selected with the following criteria in mind:

<u>AASHO</u>

1. Public indicators where they desire location
2. Twenty to thirty mile spacing
3. Inviting site
4. Shelter from climatic elements
5. Availability of drinking water
6. Availability of power and telephone lines
7. Placement of comfort station and tables
8. Utilization of natural resources

<u>FHWA</u>

9. Fitting the development to the surrounding environment
10. Preservation and utilization of natural, manmade and cultural resources.
11. Evacuation sites for emergency medical service by helicopter where possible.

(con't)

Each rest area site that was selected will be discussed as pertaining to the above criteria.

A. <u>GREAT FALLS WEIGH STATION</u>.

The weigh station, six miles north west of Great Falls, is located 37.4 miles north of the Tintinger Rest Area which is proposed on project I-15-5(13) Cascade North and South. With this spacing, another rest area site could be chosen in the vicinity of Ulm to maintain the twenty to thirty mile spacing limits.

The weigh station is located 30.7 miles south of the Teton River Rest Area which is proposed on project I-15-6(2) Teton River North and South. This spacing can be considered within the limits as set forth above.

The location of the weigh station as a rest area would serve travelers in orienting themselves prior to reaching Great Falls or the junction of U.S. 89 at Vaughn.

This sight would have partial exposure to the prevailing winds. Shelter belts could be provided for more protection.

(con't)

Although there is a well at the weigh station, the water is used for flushing toilets only. The water has been tested and is not economically feasible to purify it for drinking. See report on page 50. A cistern would have to be used as a water supply for drinking and washing. The existing well or a new well could supply water for toilets. All pipe in conjunction with the well would have to be plastic to reduce the corrosiveness of the water.

Power and telephone are available at this site which is easily accessible and can be used as an evacuation site for emergency medical service by helicopter.

In order to accomodate all facilities, considerable grading would have to be done and the ramps would have to be reconstructed.

B. <u>POWER REST AREA</u>.

The proposed rest area, 3 miles south of Power, is located 49 miles north of the Tintinger Rest Area. Again, to maintain the twenty to thirty mile spacing limit,

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another rest area site should be chosen in the vicinity of Ulm.

The Power rest area is located 19.1 miles south of the Teton River Rest Area. This spacing can be considered with in the spacing limits as set forth above.

This site has a picnic table at the present time and shows that it has public use. A man-made shelter is also provided that gives some protection to prevailing winds but more shelter will be needed. Some of the trees will have to be removed due to interstate construction and can be transplanted using the procedure as outlined in the Bureau of Public Roads report on page 66 .

Water is not available at this site and therefore a cistern or combination cistern and chemical toilets would have to be used. Power and telephones are available.

The present PTW will be used as a frontage road when the interstate is complete. Therefore the frontage road will have to be relocated around the west side of the rest area.

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C. TETON RIVER REST AREA.

This rest area site is located 32.2 miles north of the Great Falls weigh station site and 19.1 miles north of the Power Rest Area site. Both of these distances are within reason of the above established limits.

The Teton River Rest Area site is located 37.9 miles south of the Marias River Site. This distance exceeds the spacing limits but, due to the non-availability of water in this area, it should be satisfactory.

The Teton River is a natural site for a rest area. Water, Power, and telephone are available and the area provides good protection from climatic conditions.

This site should be developed so that both north-bound and south bound traffic can use it.

D. MARIAS RIVER REST AREA

The Marias River Rest Area site is located 37.9 miles north of the Teton River Rest Area. Again, this exceeds the spacing limits but, due to the non-availability of water in this area, it should be satisfactory.

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The Marias River Rest Area is located 40.4 miles from the Sweetgrass Rest Area. Again, this exceeds the thirty mile limit but a good water supply is not available over this distance.

The present highway has a roadside pullout with picnic tables which indicates a high public use. It is felt that the Marias River is a natural rest area site.

Water, power, and telephone is available and the area provides good protection from climatic conditions.

The PTW will be used as a frontage road when the interstate is constructed. Therefore, it may have to be re-routed around the northbound rest area or a separation may have to be provided for rest area access.

The southbound rest area is located north of the river and west of the PTW. Ramps can be constructed to and from the PTW and utilizing part of the PTW. It is possible a hiking trail can be made from the rest area to over look the river.

(con't)

E. SHELBY NORTH REST AREA

The rest area north of Shelby is for southbound traffic only and is located 14.5 miles north of the Marias River Rest Area. The spacing is less than the twenty mile limit set by AASHO. This rest area is 25.9 miles south of the Sweetgrass Rest Area.

This rest area was graded during the construction of the interstate. After the grading it was found that water is not available. Power is available and telephone may be available upon a thorough investigation.

The ramps would have to be revised to provide better access. A shelter belt could be provided by salvaging trees from abandoned farms. The trees would be about 8 feet and would help to develop the rest area much faster.

A cistern or combination cistern and chemical toilets could be used to provide water and comfort stations. This section of interstate has a lower traffic volume and therefore a cistern could be used to the best advantage.

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IV. SUMMARY AND PROPOSAL

IV. SUMMARY AND PROPOSAL

Each of the rest area sites have been discussed, with the exception of the two sites in the vicinity of the Vaughn Interchange. It is felt that the Great Falls Weigh Station would be a better sight because of the water.

The rest area scheme chosen is as shown on page 17. The distance between the Tintinger Rest Area and the Power Rest Area is 48.6 miles. It is felt that another rest area should be constructed in the vicinity of Ulm. The rest area spacing would then fall within the specified 20 to 30 mile limits.

The Power Rest Area was chosen over the Weigh Station site for various reasons. The Power Rest Area already indicates some use as a picnic table and trash cans are already provided. A man-made shelter is in place and more trees are within the construction limits that can be transplanted. A cistern would have to be used for drinking and washing for both sites.

(con't)

A chemical toilet would have to be used for the Power site where as water is available at the weigh station for flushing toilets. Since the water supply may cause a corrosive action, it is felt that a chemical toilet would be the best solution. The spacing from the Teton River Rest Area is considered satisfactory.

The Teton River Rest Area and the Marias River Rest Area are natural rest area sites with water power, and telephones available. The distance between them is 37.9 miles which exceeds the 30 mile limit. Because water is not available within this distance, it is felt that the spacing is adequate under the circumstances.

The next rest area that serves northbound traffic is the Sweetgrass Rest Area located 40.4 miles north. Again water is not available over this distance and therefore the 40.4 mile spacing should be satisfactory.

Grading of the Shelby Rest Area was accomplished during interstate construction and is located 14.5 miles from the Marias River and 25.9 miles from the Sweetgrass

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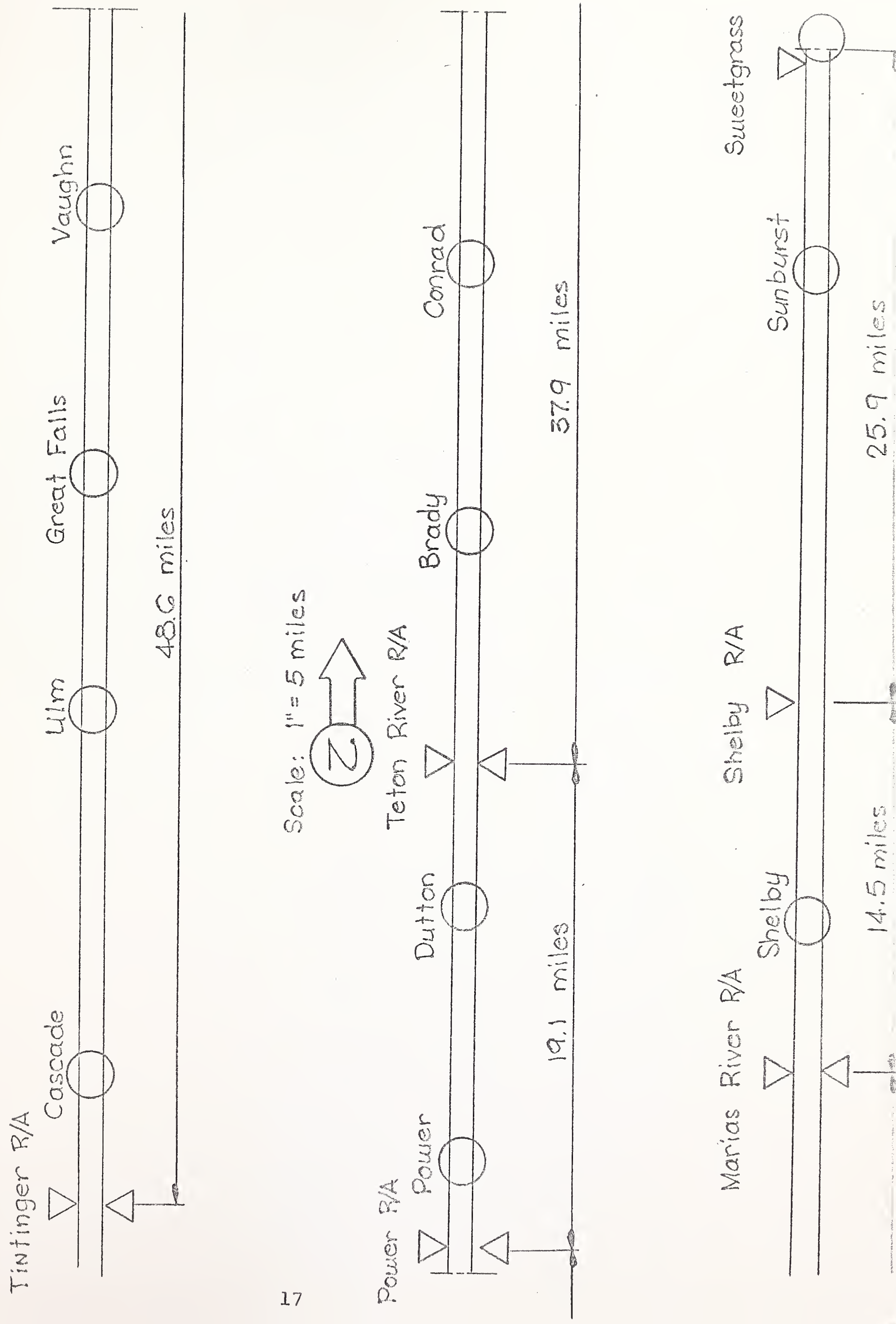
Rest Area. Because of the ideal spacing from Canada, it is felt that this rest area should be developed. It would require a cistern for the water supply and chemical toilets. Since there is no shelter at this site, a facility similar to the Tra-vel Information Center could be constructed to best advantage. The Tra-vel Information Center is located on US 89 east of Great Falls. See page 14 for pictures of this center. The placing of this center could be used to orient canadian tourists coming into Montana. It would be located prior to US 2 junction. The Tra-vel Center includes rest room facilities, telephone, picnic tables, and advertising and travel information.

The construction of the Power Rest Area should be accomplished under a separate contract because it cannot be developed in time to be let with project I-15-5(11), Vaughn North. The Teton River Rest Area is presently being developed under project I-15-6(2) Teton River North and South. The Marias River Rest Area would have to be a separate contract because it could not be developed in time to be let with project I-15-8(5) Toole County

Line North. The Shelby Rest Area could be included in project I-15-8(19) Shelby-Oilmont Jct. which is scheduled to be let to contract in February, 1972.

V. STRAIGHT LINE DIAGRAM OF PROPOSAL


Tintinger R/A
Cascade
Ulm
Great Falls
Vaughn
48.6 miles
Scale: 1" = 5 miles
N
Power R/A
Power
Dutton
Teton River R/A
Brady
Conrad
19.1 miles
37.9 miles
Marias River R/A
Shelby
Shelby R/A
Sunburst
Sweetgrass
14.5 miles
25.9 miles

VI. REPORTS

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
WASHINGTON, D.C. 20591

August 14, 1969

CIRCULAR MEMORANDUM TO: Regional Federal Highway Administrators and Division Engineers

FROM: G. M. Williams
32-90 Director of Engineering and Operations GMW

SUBJECT: Preliminary Design Guide for Rural Interstate Safety Rest Areas with Comfort Stations

The enclosed preliminary design guide is for your use and information. The guide was developed from a Summary of the 1968 National Rest Area Usage Study soon to be released by the Office of Planning.

The guide presents tentative values resulting from summarization of one year's observations. Supplemental guides on other rest area characteristics may be furnished in the future.

Judgment should be used in applying the guide as the values represent average conditions.

Enclosure

Date Recd. Preconst. 8-22-69

Act	Info	MAIL ROUTE	Attach	Initial
		37 Program Contr.		
		38 ... Roads		
		39 ... Plans		
		Other		
		File		

Schweyen

Bureau of Public Roads

Preliminary Design Guide
for Rural Interstate Safety Rest Areas, with Comfort Stations

I. Traffic data

A = 20 year ADT

B = Peak hour directional traffic = A x K x D
where: K = ratio of design hourly volume to ADT (generally about 0.135)
D = directional distribution of design hourly volume (generally about 0.6)

C = Vehicles stopping, peak hour

The percentage of vehicles stopping in rest areas varies from about 5 percent to about 13 percent, depending upon location. For example,

1) Near commercial or recreational facilities, C = B x 0.05
2) Typical rural area, C = B x 0.09
3) In an isolated area, with no nearby commercial or recreational facilities, C = B x 0.13

II. Parking requirements

M = Total parking spaces = C x 0.5

N = Car parking spaces = M x 0.8
A lower factor than 0.8 may be used if truck traffic is high

O = Truck parking spaces = M - N

III. Comfort facilities

P = Persons/hour using comfort facilities = C x 2.25
The factor 2.25 is derived by multiplying the average vehicle occupancy (3.0) by the ratio of persons using comfort facilities (0.75)

Q = Number of persons using men's facility = P x 0.5

R = Number of persons using women's facility = P x 0.5

The required facilities may be determined by entering the value for persons/hour into the following table.

Persons/hour using rest room during design hours (Q)	Number of facilities - men's room				
				Hand dryers	
	Urinals	Toilets	Wash basins	Paper towels or	Air dryers
0-105	2	2	2	2	2
105-225	3	3	4	3	4
225-315	4	4	5	4	6
315-375	5	4	5	4	7
375-435	7	4	5	5	7
435-500	9	5	7	5	8

Persons/hour using rest room during design hours (R)	Number of facilities - women's room			
			Hand dryers	
	Toilets	Wash basins	Paper towels or	Air dryers
0-105	4	3	2	2
105-225	6	4	3	4
225-315	9	6	4	6
315-375	10	6	4	7
375-435	12	8	5	7
435-500	14	8	5	8

IV. Other facilities

No specific recommendations are made concerning the remaining facilities in rest areas. Generally high usage may be expected of drinking fountains, moderate usage of trash cans and shaded tables, and low usage of fireplaces.

ATTACHMENT TO CM 32-90
DATED 8-14-59

Water Systems for Interstate Safety Rest Areas: Quantity and Quality Aspects

ROBERT L. JOHNSON, Engineering Research Institute, Iowa State University

Interstate safety rest area facilities provide unusual water use demands. The design of water system elements can be based on the peak instantaneous, maximum hourly, and maximum daily water demand rates. The peak instantaneous demand rate establishes the required pipe sizes and the capacity of elements such as the pumps to the hydro-pneumatic tanks. The water source capacity should be equal to the maximum daily water use rate while the required storage volumes are determined by the maximum hourly use rate.

Water available from natural sources such as wells is not pure. Numerous types and concentrations of impurities present in the water supply will influence the suitability of the source. The need for bacteriologically safe water is obvious. Other constituents and characteristics, such as iron, manganese, sulfates, chlorides, nitrates, and hardness, must be considered in selection of a water source. The adequacy of the available water quantity and water quality must be considered in the early planning and development of the safety rest area facilities.

The sucessful operation and maintenance of numerous rest area facilities throughout each state will depend to a great extent on the standardization of the water systems. This design approach will be particularly adaptable to the hydraulic elements and is also applicable to many of the treatment elements of the water system.

•THE ADVENT of the Interstate Highway System and the resulting large traffic volumes from "America on wheels" led to the concept of safety rest area facilities in a number of states. Individual state requirements and desires have led to a variety of creatively designed facilities. Such rest areas are a pioneering effort to furnish a service to the traveling public. The acceptance and the current rate of use in Iowa dramatically show that the rest areas provide a service that the public uses and appreciates.

Because the author is primarily familiar with the Iowa facilities, this paper is oriented toward the Iowa safety rest area development and design program. However, the material presented on the water systems should be applicable to other design solutions for rest areas of other states.

Rest area buildings provide unusual water use and water demand rates. The major problem is that there are few specific applicable guidelines from previous installations. The magnitude of the problems involved is shown by the fact that the projected water use and demand variations of each rest area building in Iowa are equivalent to the water supply for a community of approximately 100 people. However, the water demand characteristics are different from the normal domestic situation in a community.

Thirty, forty, or more of such facilities throughout each state are development, design, operation, and maintenance problems of the first order. Yet the basic underlying problem is simply to provide water for "one of those stops." The available quantity and quality of a potential water supply are factors that must enter into the planning of the rest areas at a very early stage. In fact, the availability of water in adequate

Paper sponsored by Committee on Roadside Development and presented at the 48th Annual Meeting.

amounts and of proper quality can and should dictate the site selection for the rest area and the extent of facilities to be provided at the site.

WATER DEMAND

One of the first steps in selection of a suitable water supply for a rest area facility is determining the rate of demand that will be placed on the source. The vital elements of water use demand are the average daily water consumption and the peak demand rates for various time periods important in the design of facilities, such as the maximum daily, maximum hourly, and peak instantaneous demand rates. These peak demand rates need to be estimated for determination of the pipe sizes, pressure losses, storage requirements, and pumping capacity to supply sufficient water during these periods of high water use.

Some studies (1, 2, 3) have been conducted on the flow variations at the service areas along some national turnpike and toll roads. These service areas generally provide more facilities than are anticipated in the safety rest areas. The studies point out the wide variation in demands to be expected and the rapidity with which they can occur. The data, however, are not directly applicable to the safety rest areas.

The extent and type of water-consuming devices provided in a rest area building will establish the potential water use. Traffic volumes, number of parking spaces, and other factors will determine how fully the water-using potential will be realized.

Water demands and other aspects of the water systems in the Iowa rest area buildings will be referred to for comparative purposes throughout this paper. The rest areas are usually in pairs, nearly opposite each other. Currrently, each building has a separate water system. Approximately half of each 30- by 34-ft building is devoted to rest room facilities. In total, each building has eight toilet fixtures, (water closets or urinals), four lavatories, three drinking fountains, and one service sink as the primary water-consuming devices. Two outside hose connections are provided for watering lawns.

Various portions of a water system will be designed for the water demand during particular time periods. For example, the individual pipes to each fixture must be sized to meet the maximum momentary water-use rate for that fixture at adequate pressures. The main water supply piping, however, does not need to meet the sum of all fixtures simultaneously because all fixtures will not be used at the same instant.

The peak demand flows on which to base the design of the water system should reflect the expected pattern of operation and meet the needs of the particular type of installation. Any numbers must be tempered with experienced judgment.

Peak Instantaneous Water Demand Rate

If all fixtures installed in one Iowa rest area building were used simultaneously, the total water demand would be 590 gpm (gallons per minute). Obviously, and fortunately, this will never happen. The demand imposed on building water supply systems cannot be predicted exactly. Although some fixtures, such as hose bibs, will impose a continuous water use, it must be recognized that the plumbing fixtures are used intermittently and the probability of simultaneous use of such fixtures cannot be definitely established.

A standard method (4) for estimating the peak instantaneous demand on a building water supply system has evolved that has proved to be satisfactory for many combinations of building fixtures, occupancy, and use. The studies of plumbing installations using statistical methods by Hunter (4) were a landmark in engineering design. The results of this work have been incorporated into the National Plumbing Code (5).

Numerous field tests as well as the test of time have proved that this standard method is widely applicable. In the standard method, fixtures that use water intermittently under different service conditions are assigned demand load values in terms of fixture units. One fixture unit is equivalent to a flow rate of 1 cu ft per min or 7.5 gpm. Applicable values for different fixtures are given in Table 1 (5, 6). The relationship between the total fixture units and the peak instantaneous water demand rate is shown in Figure 1.

Applying the fixture unit values in Table 1 and the relationship in Figure 1 to the rest area buildings in Iowa (79 fixture units) yields an estimated peak instantaneous water demand rate of slightly over 60 gpm. This is somewhat less than the 590 gpm based on the simultaneous use of all the fixtures. Any continuous water demand such as a connection for lawn watering should be calculated separately and added to the peak instantaneous demand. Any water system using pumping as the basic supply device should have a pumping rate nearly equal to this peak instantaneous demand rate. This situation fits the hydro-pneumatic tank and the direct booster pumping systems.

TABLE 1

WATER DEMAND LOAD OF FIXTURES, PUBLIC OCCUPANCY

Fixture	Supply Control	Fixture Units[a]
Water closet	Flush valve	10
Water closet	Flush tank	5
Urinal	Flush valve	5
Urinal	Flush tank	3
Lavatory	Faucets	2
Service sink	Faucets	3
Drinking fountain	Valve	1

[a] The given weights are for total demand. For fixtures with both hot and cold water supplies, the weights for maximum separate demands may be taken as three-fourths of the listed demand for supply.

The fixture unit values of Table 1 and the relationship to peak instantaneous water demand rate in Figure 1 show that the flush tank type of plumbing system could reduce this demand rate by about half. However, the flush tank system is more susceptible to vandalism, uses more water per flush even though at a lower peak rate, and the rate of proper fixture use is controlled by the time for refilling the flush tank. For these reasons, the flush valve system is used almost exclusively for public facilities such as the rest area buildings.

This particular peak instantaneous rate for a water system is based on considerable past operational experience, and as such is estimated on a sound basis.

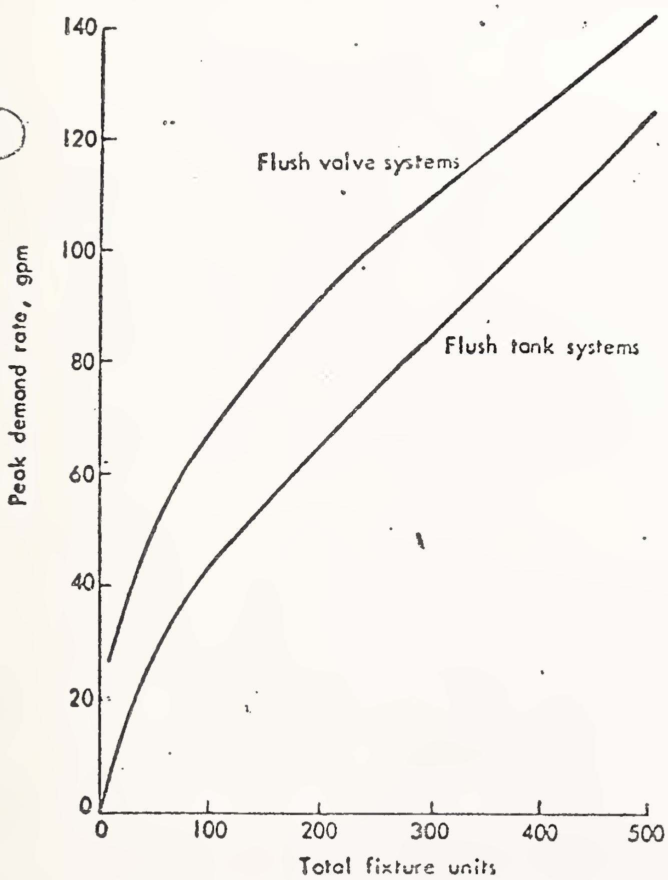


Figure 1. Demand load estimate curves.

Maximum Hourly Water Use Rate

Unfortunately, the water use rates for other time periods are not so well determined. There is a real paucity of specific data applicable to the rest area buildings.

An estimate of the ratios between the peak instantaneous and the maximum hourly water use rates can be obtained from criteria such as the "Federal Housing Authority Guide for Engineers—Rural Community Water Systems" and other criteria and studies (1, 2, 3, 7, 8, 9). It must be pointed out that none of these criteria or studies provide the desired ratio directly, peak instantaneous demand rate to maximum hourly water use rate. But by considering the ratio of average daily use to maximum daily use and the maximum hourly use to maximum daily use and in turn the estimated peak instantaneous water demand, an expected ratio of two can be reached. When this ratio is applied to the situation in the Iowa rest area buildings, the estimated maximum hourly water

use rate would be 30 gpm. It is quite apparent that this number leaves considerable room for doubt. The extension of some of the studies is difficult, but as was pointed out before, engineering judgment and common sense are required.

In an attempt to provide a more rational design basis, several studies were conducted by Iowa State Highway Commission personnel, including hourly water use readings as well as traffic counts on the main traffic stream and on the traffic into the safety rest areas. These studies confirm the validity of the rate given. By actual count, 2067 people per 16-hour day enter a single safety rest area site for an average of 130 people per hour. A great many counts at these rest area sites have established that the peak hour traffic in flow volume is about three times the average or 390 people per hour entering the site.

These studies have further shown that about 70 percent of the people use the rest room facilities. This means that during the maximum hour, about 295 people are using the rest room facilities. Estimating a water use of 5 gal (3 to 5 gal per water closet or urinal, $^3/_4$ to $1^1/_2$ gal per lavatory use), this yields a maximum hourly water use rate of about 25 gpm, which is quite close to the 30 gpm previously determined. It is interesting to note that the recommended water use criteria (8, 10) for service stations of 10 gal per vehicle will yield approximately the same water demand rate, allowing 3 people per vehicle, as previously determined.

Maximum Daily Water Use Rate

Similar considerations yield a ratio of the maximum hourly to the maximum daily water demand rate equal to approximately two. This ratio can be estimated with a fair degree of accuracy from a number of sources (7, 8, 9). Applied to the Iowa rest area buildings, this ratio would yield a maximum daily water use rate of 15 gpm.

This particular water use figure will be highly dependent on other factors, notably parking spaces provided and traffic volumes. The potential for this water use can be present, but the actual use limited. Several years of operating experience are going to be needed to more fully define this situation.

Daytime Water Use Rates

In the normal design of a water system for domestic services, the high hourly water use rates will occur in the early morning, at noon, and in the evening, roughly corresponding to meal times. Safety rest areas present a quite different pattern, as shown in Figure 2. The data shown in Figure 2 are the average and the maximum hourly water uses determined at twelve different rest area buildings in the studies by Iowa State Highway Commission personnel. As can be seen, the demand rate for a considerable length of time during the middle of the day is above the average for that day. This means that an appreciable draw will be placed on the water supply facilities for a number of consecutive hours in the middle of the day.

Also, more than 80 percent of the daily water use will occur in the 16-hour period from 6:00 a. m. to 10:00 p. m. It is for this reason that the average daily flow is such a poor design value to consider.

Summary of Water Demands

Two particular aspects of the water use variations dictate that the design basis for Interstate safety rest areas should be the maximum daily use rate with its attendent maximum hourly and peak instantaneous demand rates. First, the peak instantaneous water demand could occur on any day of the year, even the lowest water use day. In fact, a single busload of people could exert this demand rate several times during a 10- or 15-minute period. Second, the maximum daily water use rate or just slightly less will probably occur for extended periods of days during the summer vaction travel period in a pattern similar to that shown in Figure 2. The maximum daily water use rate establishes the required capacity of the water supply source. This is an important design parameter because it is anticipated that this demand rate or slightly less will be sustained for several days at a time during the high summer use period.

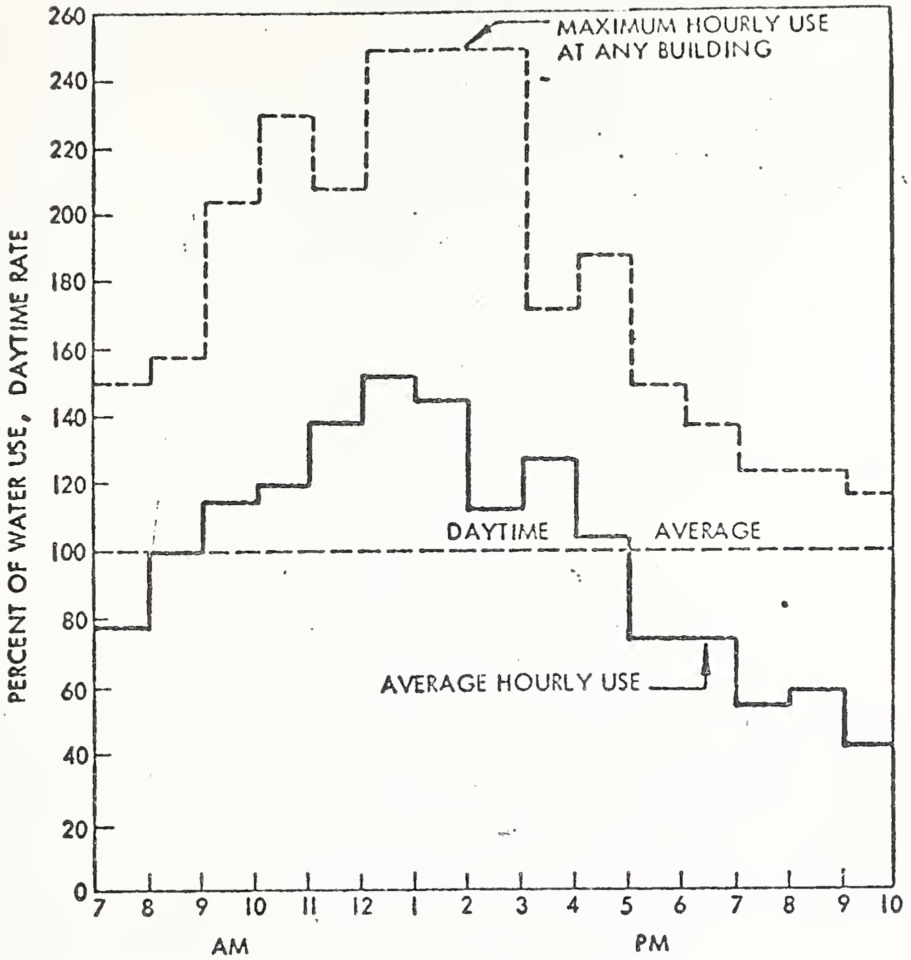


Figure 2. Interstate rest area water use variation (12 buildings).

The individual fixture water use rates determine the pipe sizes to the particular fixture. The combination of fixture units through the development of the peak instantaneous demand rate will establish the main supply pipe sizes all in accordance with standard plumbing design.

As previously mentioned, the peak instantaneous water demand also will establish the required capacity of the supply pump for a hydro-pneumatic tank or a booster pump system. The hydro-pneumatic tank is the most common installation of the safety rest area buildings.

The maximum hourly water demand rate and the rates during the daytime demand period are used in the design of storage volumes or pump cycle times, as will be discussed later.

WATER QUALITY

The quality of available water supply sources is an extremely important consideration because it will affect the design of several other elements of the water system. This parameter of quality should be considered very early in the planning stage. The quality of potential water supply sources should be considered strongly in the safety rest area site selection. People expect drinking water to be biologically safe, attractive to the senses, soft, and nonstaining as well as noncorrosive or non-scale-forming. The public will demand this type of water and will get it.

The basic criteria for water quality evaluation are the "Drinking Water Standards" of the U.S. Public Health Service (11). These standards are the criteria used by most government agencies and are obligatory for water supplies furnishing water to interstate

carriers. If not legally bound, the individual state highway agencies should certainly feel morally obligated to meet these minimum standards for drinking water along Interstate rest areas.

Water quality is determined by the bacteriological, physical, and chemical characteristics of the water. The first and most important criterion to be met is the provision of a bacteriologically safe drinking water. Well water supplies are generally quite safe, and because wells are the most common water source for the Interstate safety rest areas, the bacteriological quality is usually no problem. However, it is not axiomatic that all wells are bacteriologically safe, and well supplies should be tested, not just at the time of completion and start-up, but on a regular periodic basis. A monthly sample is the minimum that should be considered. A proper sampling program will provide an adequate safeguard for this aspect of drinking water quality.

The physical quality of a water supply is related to the temperature, color, turbidity (clarity), taste, and odor. The color and turbidity limitations of the "Drinking Water Standards" (11) are such that the general public will reject use of a water long before these particular limits are reached. The excellent quality water supplied daily by the municipal waterworks industry has set pseudo-standards of quality that the public will also demand from the safety rest areas.

The taste and odor aspect of a water is difficult to evaluate in a quantitative manner, because each person has a different sensitivity to this quality. A particular source of problems is the hydrogen sulphide odor (rotten eggs) prevalent in many well-supplies. This is easily removed in water treatment, however.

The water temperature plays an important role in the taste problem. Many tastes will not be noticeable when the water is cold. For this reason it is strongly urged that water coolers be used when the temperature of the water source is high. A single bad taste of water can ruin an individual's good will toward the rest area facilities and vista.

The third area of the standards to be considered is the limitation on certain chemical constituents. The limitations of permissible concentrations of toxic materials such as arsenic, boron, and selenium must be met. Other far more commonly found chemical constituents, the allowable concentration, and the effect of these constituents are considered in the following.

Iron and Manganese

The presence of iron and manganese can cause stains on plumbing fixtures and coatings in pipes and hot water heaters, as well as some taste problems. In addition, red or, more commonly, yellowish-red colored water will occur when the water is exposed to the atmosphere. Almost all well waters in Iowa and in many other parts of the country contain these minerals in excess of the limits of 0.3 mg/l.

Calcium and Magnesium

Hard water is caused by calcium and magnesium salts; although there is no limit on hardness per se, the magnesium level should be below 125 mg/l. The calcium and magnesium salts in hard water can cause deposits in pipes, reducing their capacity, and in hot water heaters particularly.

The possible extent of such coatings was well demonstrated in an Iowa rest area building that had an extremely hard water supply. In that instance, a 1½-in. drain pipe connected to a urinal was coated to a point where the inside diameter of the pipe was about the size of a pencil. This had occurred within about a year of operation. The possible problems in 15 or 20 years of operation are quite apparent under these circumstances. The need to soften the hard water is obvious in this instance in order to prolong the life of the piping and fixtures.

Nitrates

The presence of nitrates near the 45 mg/l level can cause nitrate-cyanosis in infants (blue babies) if the water is used in formula. Most uncontaminated water supplies are considerably below this limit, but it is an important item to consider in evaluating water quality for rest areas.

Chlorides

Above the level of 250 mg/l, particularly in conjunction with high sodium concentrations, drinking waters may have a salty taste to some people. Certain people may also experience a degree of laxative effect from this type of water.

Sulfates

Drinking waters with a sulfate concentration above 250 mg/l will produce a laxative effect on most people, particularly if the sulfate is combined with a high magnesium concentration (epsom salts). The presence of high total dissolved mineral content also promotes this laxative effect.

Many communities in the United States have water supplies that exceed these sulfate concentration limits and the inhabitants become acclimated to the water. The acclimatizing process can be discomforting under normal domestic conditions. The traveling public does not have the time to become acclimated and the laxative effect on a traveling family could be completely disastrous. Rest areas could not be spaced closely enough.

WATER SYSTEMS

Sources

There are three primary sources of water for the Interstate safety rest areas. The first and probably the most desirable, if close enough, is a municipal supply. The capital and maintanance costs involved with water supply and treatment for a rest area building could pay for appreciable pipe line construction from nearby communities. In any case, this is a first consideration when investigating water supply sources.

The second and by far the most commonly used water supply source is wells. There are relatively few areas in the United States where a well supply cannot be developed. The water quality from well supplies, however, can sometimes be less than desirable.

The third possible source is surface water such as a river or lake. Because of exposure to the atmosphere and the elements, such water supplies can be extremely variable in quality. They are always subject to pollution, and treatment will always be needed. Chlorination is the very minimum treatment possible. As such, a surface supply will present many more operational and maintenance problems than a well supply for small installations. Surface water sources should be avoided if at all possible.

Water Treatment

The wide variation in water quality that can be expected across the country means that a single series of treatment operations will not be satisfactory for every water supply. The quantity of water required will also play an important role in the treatment process selection. In fact, the relatively small size of the rest area water systems creates problems in this respect. The water systems are larger than the single-family size but considerably smaller than most municipal systems, both sizes of which have treatment processes and equipment commonly available. Because so many of the water sources are wells, the following comments are intended solely for a well supply source.

Iron and Manganese—With relatively few exceptions, iron and manganese removal for well water supplies will be needed. No one treatment method is satisfactory for all iron- and manganese-bearing waters. The soft, low pH waters of the southern and southeastern states will require entirely different treatment from the hard, neutral, or alkaline waters common in the midwestern and western states. The basic process recommended for the Iowa water supplies was pressure aeration followed by pressure sand filtration. Provision for pH adjustment or chlorination in a few well supplies was also recommended. Even then, there were some well supplies in the state with excessive carbon dioxide that were not suitable for this basic and simple process.

The iron and manganese problem occur most commonly when there is a need for relatively large storage of the water due to hydraulic capacity limitations. When the

iron-bearing water is exposed to the air, the iron or manganese is oxidized, which leads to the yellow color and turbidity of the water. This will be a problem in Iowa, where large 10,000-gal storage tanks are being installed with no provision for iron and manganese removal.

Waters that have iron and manganese only slightly above the limits can often be treated with phosphate compounds. These compounds can prevent the oxidation of the iron or manganese and thus prevent the color and stain problem.

Softening—As with iron and manganese removal, the need for softening will vary. The tendency toward corrosion or scale formation is directly related to the hardness of the water through the calcium content. The treatment process, then, becomes quite important in adjusting the characteristic of the water to a non-scale-forming or non-corrosive water.

There are situations where the need to soften is quite apparent, as in the case previously mentioned. Most water supplies will not be this hard, however. Although this limit is somewhat arbitrary, when water supplies are harder than 200 mg/l of $CaCO_3$, softening should be seriously considered.

Common commercial cation exchange units can be used to soften the water supplies in most cases. These units are cation exchangers on the sodium cycle (zeolite softening). The reduced maintenance costs and increased life of the facility fixtures and plumbing can pay for the extra cost of water softening many times over, particularly as the hardness of the water increases.

A subtle but important benefit which can often be obtained in the water softening process is that the cation exchange resins will also remove iron and manganese. In fact, these are two elements which tend to foul the resins if too much iron and manganese removal is attempted. However, for those waters where the iron and manganese level is only slightly above the recommended limits, a softening unit can provide the needed treatment in one step.

Sulfate Removal—The following comments about sulfate removal are also generally applicable to chloride and nitrate removal, all of which are extremely difficult.

One available method for sulfate removal is complete demineralization of the water, together with blending of a portion of the untreated water to provide some taste in the drinking water because demineralized water is not palatable. The only water use requiring such treatment would be the supply to the drinking water fountains, and thus the quantities involved are small. The demineralization process is expensive and requires periodic regeneration of resin beds with strong acids and strong caustics. It is not a simple process to consider and should be avoided if at all possible.

A second possibility for sulfate removal is treatment by reverse osmosis. This is one of the methods being proposed and under study for desalting sea water. Again, both the first cost and the operational costs are high. This process is currently in use and under study by the Iowa State Highway Commission; it is hoped that some results will be available in the near future.

In this writer's opinion, if the magnesium removal is provided by softening the rest area water supplies, the problem will be greatly alleviated even if the sulfate concentration is somewhat above that outlined in the "Drinking Water Standards" (11).

Provisions for Water Pressure

There are three general methods of providing the required water pressure for operation of the rest area facilities. The first to consider would be elevated water storage, either tank or standpipe type. This system has the advantage of easily providing water for the variable and peak-type water demands that exist in the rest area facilities. The primary disadvantage is the initial cost where relatively flat terrain is encountered. Freezing problems may also occur during the low demand periods in the winter months. The freezing problems can be handled by judicious operating procedures. For example, only a portion of the storage volume available could be used during low demand periods to insure adequate turnover of the stored water to prevent freezing. The cost problem in flat terrain still remains. Where the terrain is favorable, i. e., a hill 40 to 50 ft or more above the rest area buildings, this type of

pressure supply is recommended over all others, particularly when the rest area buildings are in a pair and can be combined into one water system.

There are a number of design possibilities for elevated storage, such as architectural treatment for aesthetics and incorporation into uses such as lookout towers. This is an area where some very original and creative designing is possible. Whenever possible, the provision of elevated storage should be considered as the first alternative to provide water pressure. In fact, this could and should be incorporated into the planning process of site selection.

The second possibility is booster pumps used in parallel to provide the water pressure required with only nominal storage for pump suction purposes. This type of pressure system is well-suited to a fairly uniform water demand with only occasional periods of high usage. This is not the type of water demand experienced at the rest areas, and thus this type of direct booster pumping system is not applicable.

The third possibility is a hydro-pneumatic tank system, which is the system presently used in most rest area facilities. Although not as well-suited to widely varying demand rates as is elevated storage, a properly designed hydro-pneumatic system will function very satisfactorily. A common misconception about the hydro-pneumatic tank is that it provides water storage. It does not. The primary purpose of a hydro-pneumatic tank is to provide water pressure between certain limits, commonly 40 to 60 pounds per square inch (psi). The ability of a hydro-pneumatic system to meet the peak water demands is dependent solely on the capacity of the pump supplying the hydro-pneumatic tank. This pump should be equal in capacity to the peak instantaneous demand rate in order to insure proper use of all the fixtures.

The total tank volume required is determined by the number of pump cycles that can be tolerated during the maximum hourly water use period. The maximum recommended number of pump cycles per hour varies from two to ten depending on the guidelines used and on the degree of reliability required. Ten cycles per hour is the most common recommendation for the normal 1800 rpm pump motor. The number of cycles per hour is reduced as the horsepower and/or the speed of the electric motor increases.

As shown in Figure 2, the water demand rate for the period from about 10:00 a. m. to 3:00 p. m. is sustained only slightly below the maximum hourly demand rate. The commonly used submersible well pump motors generally operate at 3600 rpm. In view of this it is recommended that, when a well pump supplies a hydro-pneumatic tank directly, the number of pump cycles per hour be limited to five. However, when booster pumps (which operate at 1800 rpm) supply the hydro-pneumatic tank, the number of pump cycles per hour can be increased to ten.

On this basis, the pump supplying the hydro-pneumatic tank for the Iowa rest area buildings should be capable of meeting the peak instantaneous demand of 60 gpm previously determined. Likewise, for a maximum hourly demand rate of 30 gpm previously determined, the total volume of the hydro-pneumatic tank should be 360 gal for an 1800-rpm booster pump. The tank would need to be 720 gal if a 3600-rpm well pump is used. Both of these volumes are based on using the 40- to 60-psi operating range.

The maximum possible volume of the hydro-pneumatic tank used per cycle when operating at the 40- to 60-psi range is 27 percent, if the tank is 27 percent full at 60 psi and empty at 40 psi. This is not particularly satisfactory in practice, and generally the hydro-pneumatic tank would be operated so that the tank is 30 percent full of water at 60 psi and 5 percent full at 40 psi, thus allowing some safety factor.

In order for the hydro-pneumatic system to function properly, controls should be provided to add or vent air as required and thus maintain the proper air-water ratio in the tank.

Operation and Maintenance

One of the most important features that must be designed into rest area water systems is simplicity of operation. It is important that all of the equipment and treatment processes selected be simple, automatic, and essentially free of the "human element." The desired water system design and equipment should produce excellent

quality water satisfactory to all people, even when the system and equipment is improperly operated and not maintained. This is somewhat of a Herculean task and not a design problem for the novice. Qualified expert design advice is needed. The problems of the small water system are practically as complex as the much larger municipal and industrial water systems.

The operation and maintenance of these water supply systems at scattered locations throughout each state will be difficult. Just the problem of spare parts for 30 or 40 well pumps, each slightly different, is unpleasant to contemplate. Multiply this problem by the five to ten major components of each water system and a real nightmare could occur.

The need for standard design water systems is apparent. Yet, as was pointed out earlier, each water supply source will have different quality and quantity aspects. Nevertheless, it is possible to standardize many of the major components of the water systems. For successful operation, the rest area water systems must have a high degree of interchangeability of all elements. This may mean a limited degree of overdesign in the case of some installations.

In Iowa highly standardized water systems have been recommended and partially implemented, particularly the hydraulic components such as well pumps, booster pumps, and hydro-pneumatic tanks. This is further outlined in the Appendix and is a major item of design consideration.

A second item which should be obvious, but is neglected in many designs, is the provision of adequate space for the equipment needed. It will be impossible to properly operate and maintain the water system equipment if too little space is allowed.

BASIC DESIGN RECOMMENDATIONS

1. Because the rest area facilities are a water supply service to the public, the water supply capacity and water quality should be an important and early factor in planning the rest area facility. It is strongly urged that the exploration for the water source be completed before final site selection is made. Many operational problems can thus be prevented.
2. Owing to the expense involved with wells and water treatment processes, it would be desirable to use connections to municipal water supplies whenever possible.
3. To reduce the overall costs of the water systems and to increase the treatment process unit capacities to more desirable levels, the water systems of the rest area buildings, if in pairs as in Iowa, should be combined whenever possible.
4. Whenever the topography is favorable, elevated storage should be used to supply water pressure.
5. The water systems should be capable of supplying the estimated peak instantaneous water use rate for the required short durations.
6. Because the water use rate during the midday hours is often near the maximum hourly use rate, the essential elements of the system should be capable of sustained operation at or near the maximum hourly demand rate.
7. The capacity of the water supply source should be at least equal to the estimated maximum daily water use rate.
8. The maintenance and operational problems involved with the number of different water systems in each state is staggering to contemplate. As discussed earlier, a high degree of standardization of all elements is essential. This is often difficult to attain under the bid procedure limitations of public agencies, but the potential savings to the public far outweigh the bidding problems.
9. A second area of maintenance and operation to be considered is the personnel involved and management organization. The problems will be quite different from those previously encountered by highway personnel. A staff either within the existing organizations or separate trained and educated in this area of engineering, may be needed for successful operation and maintenance of the rest area facilities.

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Appendix

IOWA REST AREA WATER SYSTEM SCHEMES

The following material is included to demonstrate that standardized designs are possible and feasible. The following water system schemes were recommended to the Iowa State Highway Commission and have been partially implemented, with other portions of the schemes to follow.

The main body of this paper has shown the development of the various demand rates for the Iowa rest area buildings. These are shown in Table 2. Most of the well water supplies in Iowa will require iron and manganese removal and softening. The development of the proposed water schemes is guided by these two treatment processes, if needed.

The following schemes are based on use of a hydro-pneumatic tank system to provide pressure; however, the schemes can be easily adapted for use of elevated storage where the topography allows.

Proposed Water System Schemes

The possible arrangement of the water systems is quite varied depending on well capacity available, treatment required (i. e., softening only or iron removal plus softening), and whether or not the water systems of the rest area building pairs can be combined. The following schemes take into account the wide variation possible in each of the three variables.

Scheme A-1—This scheme fits the following situation: (a) well capacity is 60 gpm or more; (b) softening is the only treatment required; and (c) each building water system is separate. In this scheme the well pump would discharge through the softening unit into two 360-gal hydro-pneumatic tanks. This is the simplest and most inexpensive system. However, it fits a situation found infrequently in Iowa, because most well waters require iron removal.

Scheme A-2—The following situation is applicable for this scheme: (a) well capacity is about 30 gpm; (b) softening is the only treatment needed; and (c) each building water

TABLE 2

ESTIMATED WATER DEMANDS FOR IOWA INTERSTATE SAFETY REST AREA BUILDINGS

Water Demands	Flow Rate (gpm)[a]	Flow Rate (gpd)[b]
Peak Instantaneous	60	86,400
Maximum hourly	30	43,200
Maximum daily	15	21,600
Average daily	4	5,760

[a]Gallons per minute.
[b]Gallons per day.

system is separate. The system arrangement would have the well pump discharging through the softening unit into an intermediate storage of 1000-gal capacity. A 60-gpm booster pump then would take suction from the intermediate storage and discharge into one 360 gal hydro-pneumatic tank. As can be seen, this system is quite similar to Scheme A-1.

Scheme A-3—This scheme is identical to Scheme A-1 except that the well capacity is now about 15 gpm (the estimated maximum daily demand) and the intermediate storage volume required is 3600 gal.

Scheme A-4—This scheme is identical to Scheme A-1, except that the well capacity is 60 gpm and two 60-gpm booster pumps, one for each building, take suction from the 1000-gal intermediate storage. In other words, the two building water systems are combined.

Scheme A-5—In this scheme the two building water systems are again combined with a well capacity of 30 gpm and 7200 gal intermediate storage is required. The scheme is identical to Scheme A-4 except for the intermediate storage volume.

The A-series of schemes can be further compressed by providing an intermediate storage volume of 7200 gal minimum whenever intermediate storage is required. This allows development of only two basic plans when only softening of the water is required:

Plan A—In this plan, (a) well capacity is 60 gpm, (b) each building water system is separate, and (c) the well pump discharges through the softening unit into two 360-gal hydro-pneumatic tanks.

Plan AA—In this plan, (a) intermediate storage is 7200-gal capacity; (b) well capacity is 30 gpm and the sides are combined, or the well capacity is 15 gpm and the sides are separate (note that there is no advantage to having a well capacity greater than 30 gpm in this case); (c) the well pump discharges through the softening unit into the intermediate storage; (d) booster pumps of 60-gpm capacity, either one or two, are provided; and (e) the booster pumps take suction from the intermediate storage and discharge into 360-gal hydro-pneumatic tanks, one per side.

The following B-series of schemes can be organized into a similar pattern when iron and manganese removal is required in addition to softening. There is one additional restriction to be considered when iron and manganese removal is required. The additional limitation is that a minimum time period for filter run of about 3 hours is required to prevent the "flush-out" from the filters of the iron and manganese that has previously been removed. The flushing effect would occur under a frequent start-stop condition; thus there is no Scheme B-1 comparable to the Scheme A-1. Because of this limitation, the intermediate storage volume must be larger than the comparable A-series schemes.

Scheme B-2—In this scheme the following is applicable: (a) well capacity is 30 gpm; (b) iron, manganese, and softening treatment are needed; (c) each building water system is separate; (d) the booster pump is 60-gpm capacity; (e) intermediate storage volume is 7200 gal, dictated on minimum filter run length, assuming three-fourths of the storage volume is used in the operational cycle; (f) the well pump discharges through the iron and manganese removal unit into the softening unit and in turn into the intermediate storage; and (g) the booster pump takes suction from the intermediate storage and discharges into a 360-gal hydro-pneumatic tank.

Scheme B-3—This is identical to Scheme B-2 except that the well capacity is 15 gpm and the intermediate storage volume of 7200 gal is dictated by the need to meet the water demands and not by the minimum filter run lengths. Thus there is no advantage to having the well capacity greater than 15 gpm if the building water systems are separate and iron and manganese removal is required.

Scheme B-4--This is identical to Scheme B-2 except that the well capacity is 60 gpm and the building water systems are combined. The intermediate storage volume of 7200 gal is again dictated by the need to have a minimum 3-hour filter operational run.

Scheme B-5—This is identical to Scheme B-2 except that the building water systems are combined and the 7200-gal intermediate storage volume is dictated by the need to meet the water demand.

It is interesting and unusual that the B-series of schemes is essentially identical. As can be seen, there is no advantage to having the well capacity greater than 30 gpm if the building water systems are combined or greater than 15 gpm if separate. In fact, there is a disadvantage of larger capacity wells in that the treatment units would have to be larger and more expensive.

The B-series can be reduced to one plan which is very similar to Plan AA:

Plan B—In this plan, (a) intermediate storage volume is 7200 gal; (b) well capacity is 30 gpm and the water systems are combined, or the well capacity is 15 gpm and the water systems are separate; (c) the well pump discharges through the iron and manganese removal unit into the softening unit and then into the intermediate storage; (d) booster pumps of 60-gpm capacity, either one or two, are provided; and (e) the booster pumps take suction from the intermediate storage and discharge into 360-gal hydro-pneumatic tanks, one per side.

At this point, there are really only two basic plans, Plan A and Plan B, since Plan AA is only a special case of Plan B where iron and manganese removal is not required. These two plans will cover quite a wide variety of possible well capacities and water qualities. The advantages and disadvantages of these plans are summarized below. The plans are shown schematically in Figure 3.

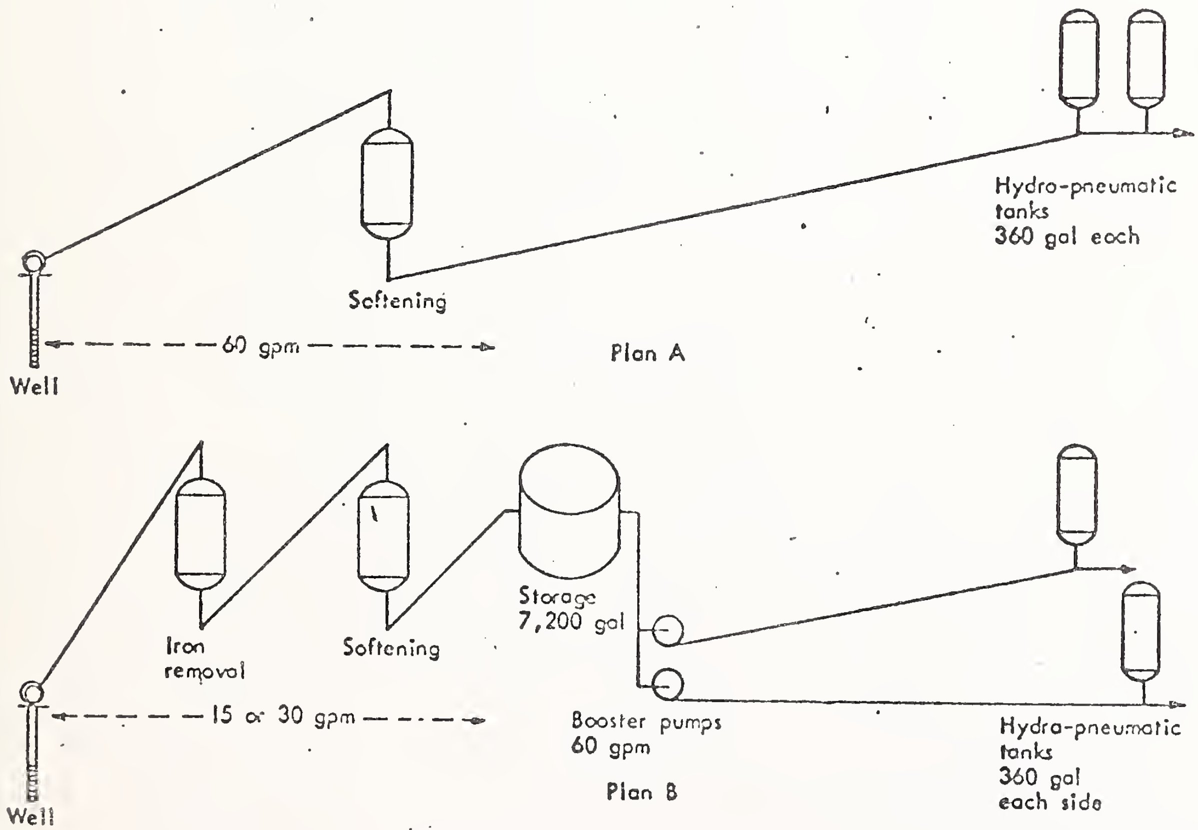


Figure 3. Basic water systems.

Advantages

1. Well pumps are used in only three capacities—60, 30, and 15 gpm; the majority will fall into the 30-gpm category.
2. The intermediate storage volume of 7200 gal is identical in all cases.
3. The booster pumps of 60-gpm capacity used will all be identical.
4. The hydro-pneumatic tanks will all be the same size, 360 gal, installed either singly or in pairs to meet the various situations.
5. A high degree of standardization can be achieved in well pumps, booster pumps, hydro-pneumatic tanks, treatment units, and controls.
6. When the building water systems are combined, the piping can be easily arranged to serve both sides from one booster pump, thus increasing the relability of the service.
7. Where the topography is favorable, the intermediate storage should be elevated storage, thus eliminating the booster pumps and the hydro-pneumatic tanks.
8. The use of intermediate storage provides a limited source of fire-fighting water.

Disadvantages

1. In the case where no iron removal is needed, the intermediate storage is oversized to some extent. However, the number of cases where iron removal will not be needed in Iowa will be in the minority. The relative cost of this oversized segment is quite low.
2. There may be occasions when chlorination could be required since the water will be exposed to the atmosphere before use and the potential for contamination is increased. With proper design, this need will be rather rare.

CISTERNS FOR WATER SUPPLIES
Montana State Board of Health
Division of Environmental Sanitation

Circular No. 17

Water which is to be used for drinking and various household and family purposes may be satisfactorily stored if the proper provisions are made. The purpose of this circular is to guide those who find this method of providing a water supply necessary. There are localities in Montana in which no satisfactory well waters are to be found and cisterns appear to be the only means available by which an adequate and satisfactory water supply can be provided.

The circular discusses the proper location, construction and operation of cisterns; the sources of water for filling them, how such waters should be handled between the source and the cistern, and how water may be dispensed in a public place such as a school.

Cisterns for Water Supplies

A discussion of the sanitary features of cisterns which may be built for use at rural schools and homes.

Location

The best location for the cistern is near the building, on well-drained land and at least 100 feet from any privy, cesspool or stable. Any sewers located within 50 feet of the cistern should be of iron or other watertight construction.

Construction

Size and Shape: Whether the cistern be rectangular or round is not a matter of sanitary significance. More capacity with the same amount of concrete is obtained with a round cistern. The rectangular cistern is probably more easily built because of the ease with which the forms are placed.

The size to be built will depend upon the number of people to be supplied, the amount of water each person uses and the length of time between fillings. Suppose that each of 5 people use 20 gallons each day and that there will be four months between fillings:

5 x 20 x 120 days = 12,000 gallons

12,000 gallons divided by 7.5 = 1600 cubic feet
(1 cubic foot of water is equal to approximately $7\frac{1}{2}$ gallons)

Table No. 1 gives capacities in gallons of square and round cisterns of various sizes with varying depths of water.

Material: Concrete is the best material to use. Brick is acceptable if laid with cement mortar and covered with a watertight coating of concrete. The cistern must be watertight throughout to prevent leakage and waste of the stored water and also to eliminate any chance of seepage entering the cistern from the surrounding ground.

Design of Top: The top should be built of watertight material, best of concrete, with protected openings for entrance and for any pump which may be installed. Protection against water or contaminating material entering through the manhole is attained by means of a sill not less than three inches high and two inches thick built around the opening. This sill should be of concrete also, and poured at the same time as the top so as to obtain a watertight job. The lid for this opening is then made of concrete or of wood covered with sheet metal. (See Fig. 1 and Fig. 1A).

If a hand pump is installed on the top of the cistern, it should be over an opening which is also protected. The means of protecting this opening is shown in Figure 2.

This illustrates how a metal collar is placed through the top, large enough to allow the pump cylinder to pass and extending upward to fit snugly into the base or "foot" of the pump. The pump is to be bolted to the cistern top with bolts set in the concrete when poured. Note how the pump is set on a raised base formed in the cistern top.

The top of the cistern must fit tightly against the top of the side walls and be watertight at that point of contact. If the walls and top are poured at the same time, this will insure a tight joint.

If the pump is located in the building adjacent to the cistern, the suction pipe will enter the side wall. There must be a tight fit where this pipe goes through the side wall to prevent the entrance of any contaminating material at that point. This is shown also in Figure 2.

Setting of Cistern: The cistern should be set in the ground at an elevation that brings the top above ground level at least six inches. If the owner desires to bury the top of the cistern where the pump is located in an adjacent building, the sills of the manhole or entrance must be extended to provide a top which is at least six inches above the ground level.

Ventilation: Cisterns, as a general rule, should be ventilated. The arrangements for this need not be elaborate, but should be strong in construction and should be protected against possibilities of contamination of the water. An iron pipe, three or four inches in diameter, set in the top of the cistern with the outer end turned downward and screened makes a good ventilator. This type is shown in Figure 2.

Drain: It is convenient to have a drain pipe and a valve with which to empty the cistern, especially for cleaning. One is shown on the sketch (Fig. 2). Such a drain can be installed if there is sufficient slope to the ground so that the drain pipe comes out to the surface, as for instance on a hill side or bank of a nearby coulee or ravine. This pipe should slope slightly away from the cistern, and should be at least two inches in diameter. It should be set so that the cistern will drain completely. It should never be connected to a cesspool or a sewer.

Recommended Procedure for Concrete Cistern Construction

Excavation: Sufficient excavation should be made beneath the floor of the structure to allow for a four or five-inch mat of well compacted pit-run gravel to be placed.

Cement: The cement used for this work should be of a standard brand of "Sulphate resisting" Portland cement which has been properly stored and protected against dampness. Cement that has for any reason become partially set or contains lumps of caked cement should not be accepted for this work. The cement sack contains one cubic foot of cement which weighs 94 pounds.

Sand: This fine aggregate should consist of a washed natural sand free from clay balls, coal, cinders and organic matter, or any other deleterious substances and should be well graded.

Gravel: This coarse aggregate should consist of a sound screened gravel or crushed rock, uncoated and well-graded that will be retained on a screen having $\frac{1}{4}$-inch round holes and the material should have a maximum diameter of $1\frac{1}{2}$ inches.

Water: The mixing water should be free from oil, acids and injurious amounts of vegetable matter, alkalies or other salts and should not be used in excess of six gallons per sack of cement including moisture in the aggregate.

Mixing: The proportioning of the sand and gravel should be done by weight measurements after trial batches have determined a suitable mixture that is workable and plastic with a maximum of 6 gallons of water per sack of cement. The ratio of cement, sand and gravel should be approximately 1 : $2\frac{1}{2}$: $4\frac{1}{2}$ and the mixing time should be at least one minute after the material has been placed in the concrete mixer. For hand mixing, mix cement and sand dry on a wood or steel platform, spread the mixture to a uniform thickness, then spread the gravel on top, apply the necessary amount of water, and turn with square pointed shovels to a uniform mixture.

Reinforcing: Deformed reinforcing iron $\frac{1}{2}$-inch in diameter should be used as shown in Figure 2, and spaced approximately 9 inches on centers both ways with the reinforcing mat placed closer to the bottom surface of the cistern top.

The concrete mixture should be neither too dry or too wet and should puddle freely without segregation.

Curing: New concrete, which is exposed to the air and weather, should be protected by a double thickness of wet burlap for the first eighteen hours. After that several inches of damp earth should be used as a protection for at least four or five days.

Source of Water

Cisterns may be filled with water from a spring, a well, the house roof or an irrigation ditch.

Spring or Well: In the case of a spring or well, the water will doubtless be hauled, in which case it is necessary that the original spring or well be properly located and constructed. (Separate circulars concerning these are available from the State Board of Health).

Provisions for Hauling Water: It is also highly important that the container or containers used to bring the water to the cistern be of proper construction and kept in a clean condition and used for this purpose only. If a tank wagon or truck is used, it should be used for hauling drinking water only. Occasionally it should be disinfected if used constantly. If used on rare occasions only, it should be disinfected before each use.

For disinfection of the tank, use the ordinary chlorinated lime to be found usually in grocery and drug stores. For each 500 gallons capacity of tank, use at least a heaping tablespoon of the powder made into a thin paste or "slurry" in a cup or bowl. After thorough mixing of the powder and water, pour it into a pail and fill with water. Allow to settle for a few minutes and pour off the clearer water into the tank. Then put in the tank enough water to produce a good splashing when the tank is moved quickly forward and backward which can be done by moving the truck or wagon quickly. This action splashes the disinfectant over the sides and all around the walls of the tank. After this, let the tank stand for an hour or two, drain off the disinfectant and rinse the tank with a generous supply of clean, pure water. The tank is then ready for use for hauling water.

Water from House Roofs: Not often is there a dependable source of water from a roof unless the building or buildings which are available for catching the water are large. Our annual rainfall is not sufficient to produce much water. If, however, rain water is used, a filter should be built between the roof and cistern.

Filter: Such a filter should be made of sand and pulverized charcoal in alternate layers and laid on a gravel base. It may be that a filter for such a purpose can be purchased through the local hardware dealer. Any filter should have a surface area not less than four square feet.

Water from Irrigation Ditches: If water is taken from an irrigation ditch it will probably be run from the ditch to the cistern by gravity. A filter is always desirable in such cases and must usually be set below the ground elevation. The side walls of the filter then should be built up to a few inches above the ground and the filter should have a cover over it. A pipe laid at the proper elevation will have to be provided to carry the water from the filter to the cistern. Where this pipe enters the cistern, it must be sealed tightly.

In such cases too, the cistern top should be raised up so as to be above the elevation of the surrounding ground. In other features the cistern construction can be the same as described above.

When water comes from irrigation ditches, it should be disinfected and a separate circular of instructions, sent upon request, gives instructions for this.

Purification of Cistern Water: Calculate the number of gallons of water in the cistern. If the cistern is square or rectangular, determine the area in square feet, multiply by the depth of water in feet and then multiply by $7\frac{1}{2}$ to determine the number of gallons.

If the cistern is round, determine the area by multiplying the radius squared (r^2) in feet by 3.1416. Then multiply by the depth of the water in feet, and then by $7\frac{1}{2}$ to determine the number of gallons.

Example: For a round cistern -

Suppose the diameter is 10 feet. The radius is then 5 feet. The radius squared is 5 x 5 or 25.

25 x 3.1416 = 78.54 square feet.

Suppose the depth of water is 8 feet.

78.54 x 8 = 628.32 cubic feet.
628.32 x 7.5 = 4,712.4 gallons.

For other dimensions use the proper figures as shown above.

The most simple way to disinfect a cistern is by the use of a laundry bleaching solution. One-half pint of laundry bleach such as Hilex, Chlorox, Purex, etc. per each 1,000 gallons of water is usually sufficient for treatment. Other materials such as chloride of lime or high test calcium hypochlorite (HTH or Perchloron) can be used.

$\frac{1}{2}$ pint liquid laundry bleach = 3 tablespoons chloride of lime or about 1 tablespoon of high test hypochlorite.

If chloride of lime or calcium hypochlorite is used, the following directions should be followed:

Break up all lumps in a small portion of the powder. To the measured quantity of bleaching powder add a few drops of water, stir and make a thick paste. This operation can conveniently be carried out in an ordinary bowl. The paste is then diluted with water and this thinner paste should then be poured into a 5 or 10 gallon pail of water. Allow the sediment in this solution to settle for a few minutes. Then pour the solution into the cistern and thoroughly mix it with the cistern water. This can be done with a pail to which is attached a rope. The pail can be alternately filled with water and emptied back into the cistern to assist in properly mixing, or the pail could be filled with water and then dropped from a convenient elevation back into the cistern again. Mixing can also be done by recirculating the water through the pump and back to the cistern by use of a hose.

After thoroughly mixing the chlorine solution with the cistern water, allow the action to continue for 20 to 30 minutes. Fill a drinking glass with water from the cistern and add a few drops of ortho-tolidin solution. If a slight yellow color appears when viewing the water through the glass placed in front of a white sheet of paper, then it is certain that the proper amount of bleaching powder has been added. When this color appears, it means that there is an excess of chlorine in the water which will destroy germs of the intestinal type in a very few minutes.time. If no yellow color appears on addition of the ortho-tolidin, then it means that more of the chlorine solution should be added to the cistern.water. In that event, add a little more of the chlorine solution and repeat the color test with the ortho-tolidin. If this procedure is properly carried out, there will be no disagreeable odors and tastes left in the water. This method of water disinfection is perfectly safe and effective when controlled by the ortho-tolidin test.

Citizens of the state desirous of using this method of disinfecting cistern water may secure the necessary ortho-tolidin upon request to the State Board of Health.

Dispensing Water at the School

Common drinking cups are prohibited by law. It becomes necessary, therefore, to provide other means for dispensing drinking water. Where plumbing is installed, a drinking fountain is the best. The fountain stream should issue on a slant and the fountain nozzle must be protected against the drinkers' lips. The larger plumbing companies furnish drinking fountains of good design.

Cups: If there is no plumbing in the building, individual cups may well be used. These may be brought by each pupil and this is satisfactory provided the cups are kept separate and clean. The tendency is for the pupils to use each other's cups in which case the purpose of the individual cup is lost.

Paper cups are good, and are to be recommended. They are economical when used properly and are not wasted.

The Water Container: Any good stoneware jar with a self-closing nickel faucet at the bottom is acceptable. This should be set on a shelf or table, with paper cups in a dispenser on the wall nearby. A pail to catch the drippings should be placed under the faucet and a clean pail, kept in a closed cupboard and only for the purpose, should be provided with which to fill the container. A basket or pail should be placed nearby for the used cups which should be crushed by the user when discarded. This is a system which is as sanitary as can be attained.

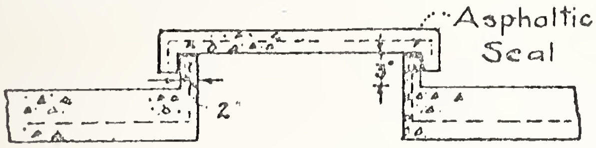


Fig 1. Pillbox type of lid for hatchway.

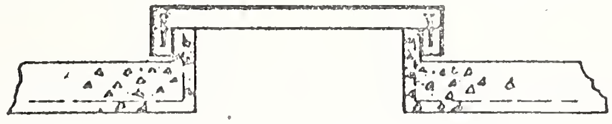
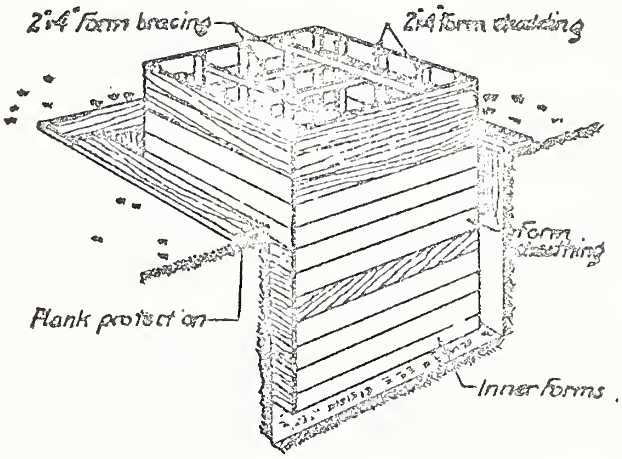


Fig 1-A Wooden plank pill box lid. Sheet metal covered.

Fig. 1 or 1 A Pill box type of lid or cover for man-hole.

This illustrates the cross section of the top of the cistern and shows how the sills are made and how the cover is made and set in position (The cover may be made of boards covered with sheet metal with edges turned down over the sills in case this type of cover is used, it should be provided with a lock to hold it in place.

Suggested method of building and installing inner forms where earth walls of the excavation serve for outer forms. Planks laid flat as shown help prevent caving of sides of excavation.

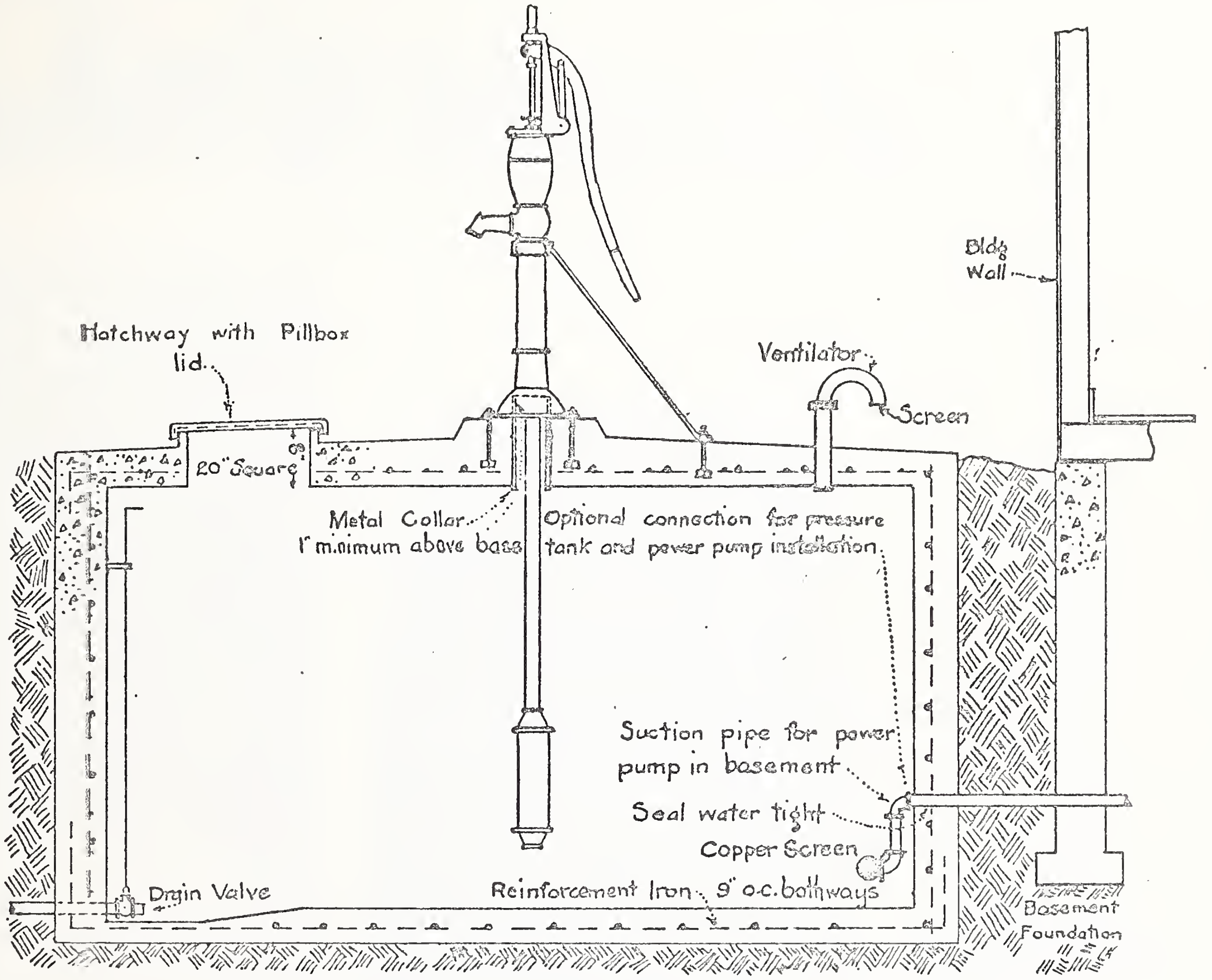


GENERAL VIEW OF INNER FORMS

TABLE I
Capacities of Square & Round Tanks & Cisterns in Gallons.

Depth in feet.	Square Tank Sizes		
	8 ft. sq.	10 ft. sq.	12 ft. sq.
4	1920	3000	4320
6	2880	4500	6480
8	3840	6000	8640
10		7500	10800
12			12960

Depth in feet.	Round Tank Sizes		
	8 ft. dia.	10 ft. dia.	12 ft. dia.
4	1510	2360	3400
6	2260	3540	5100
8	3020	4720	6800
10		5900	8500
12			10200



CISTERN

CROSS-SECTIONAL VIEW. FIG. 2

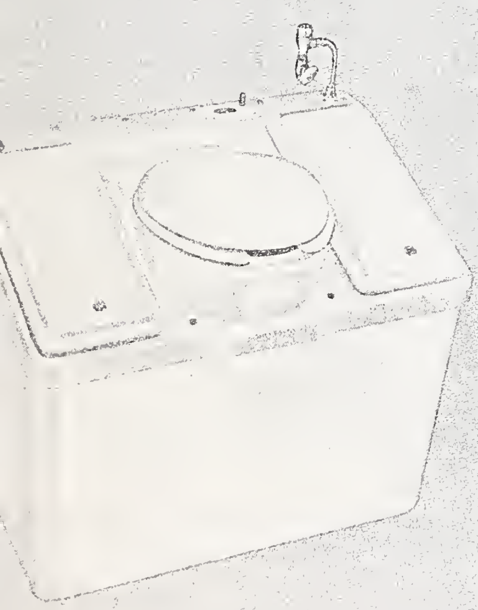
NOTE: NO SCALE.

Fig. 2- Which is not drawn to scale, is primarily intended to illustrate the various important features listed below, of a storage reservoir or cistern.

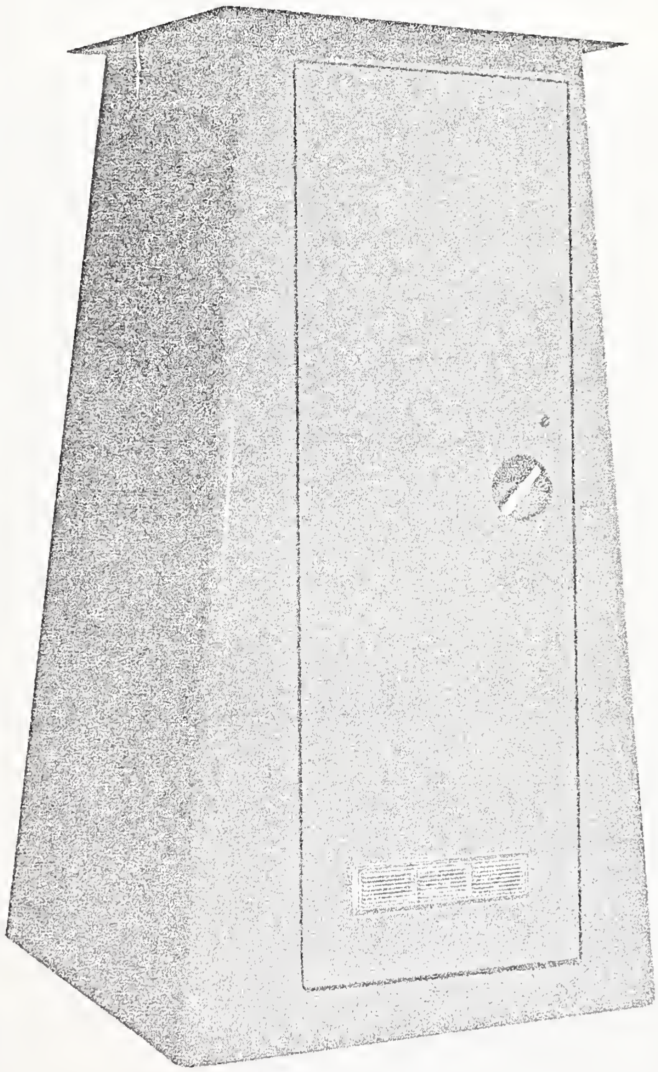
1- Pill box type hatchway lid.
2- Top, sloping in all directions away from pump base.
3- Screened ventilator.
4- Seating of hand pump on raised concrete base over metal collar in cistern base.
5- Suction pipe where basement power pump is used.
6- Location of drain pipe in slight depression in floor of cistern.
7- Reinforcement iron.

originators and manufacturers of flushing toilets for all Douglas DC-8, Boeing 707, 737 and 747 jet airliners and world's largest suppliers of mobile sanitation systems to the recreational vehicle, marine and hospital industries — presents the

Jet-o-matic ™



MODEL 1000M



MODEL 1000FE
PATENT PENDING

MODEL 160M

A TOTALLY NEW CONCEPT IN PUBLIC SANITATION FACILITIES

Jet-o-matic raises the standard of public sanitation to the high level provided by Monogram to every jet airline in the world. Innumerable applications await this advanced concept.

Monogram Industries, Inc. / [illegible] ARIZONA CIRCLE, LOS ANGELES, CALIFORNIA [illegible]

IMPORTANT FACTORS IN SELECTING THE...

The electrically-operated, recirculating, self-contained, flushing toilet has performed millions of times with complete reliability in commercial jet aircraft, trailers, campers, boats, cabins and hospitals.

The is easy to operate. With a press of a button, a vigorous, forceful flushing action thoroughly cleans the bowl. Each flushing cycle is automatically timed.

The series enables you to select precisely the best unit to meet your particular need.

Fiberglass, ABS plastic and stainless steel construction assure many years of all-weather service, free from repair and maintenance.

The series all operate on: (1) 12-volt battery or (2) conventional 110-volt AC (when used with the MONOVOLT CONVERTER).

The formulation of MC-1000 chemical is the result of more than twelve years of research, testing and proven dependability of Monogram Sanitation Systems throughout the world.

The control module houses all electrical and mechanical components.

The series are all designed for vandal-proof use.

Gleaming stainless steel bowl of is durable, attractive and remains clean under heavy use.

The series is easily portable.

The users will be more satisfied than with conventional temporary sanitation.

MODEL 1000M

The Model 1000M makes it possible to have modern sanitation anywhere! This attractive, self-contained toilet can be used wherever conventional plumbing is impractical or impossible to install! The 1000M can be included in your sanitation system whether you plan new construction or must convert existing facilities, such as comfort stations, outdoor toilets, shelter houses, etc. An extra room can be converted to a bathroom in minutes with this compact unit. Only 33" X 36" X 24", it can fit virtually anyplace!

Its large capacity and infrequent service requirements make this toilet ideal for high-rise construction sites, isolated locations, tunnels and other applications. Old fashioned sanitation equipment creates costly delays and an unattractive environment. Monogram's unique chemical dispensing system controls odor and bacteria growth throughout the 1000 uses.

Simple maintenance takes only a few minutes. The non-porous plastic and fiberglass can be wiped clean with a moist cloth.

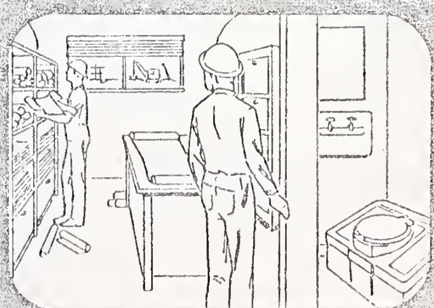
An initial charge of 12 gallons of water mixed with MC-1000 chemical is all that is required to put the 1000M in readiness.

The 1000M operates on: (1) self contained 12-volt DC battery or (2) conventional 110-Volt AC when used with the MONOVOLT CONVERTER, Model 10A.

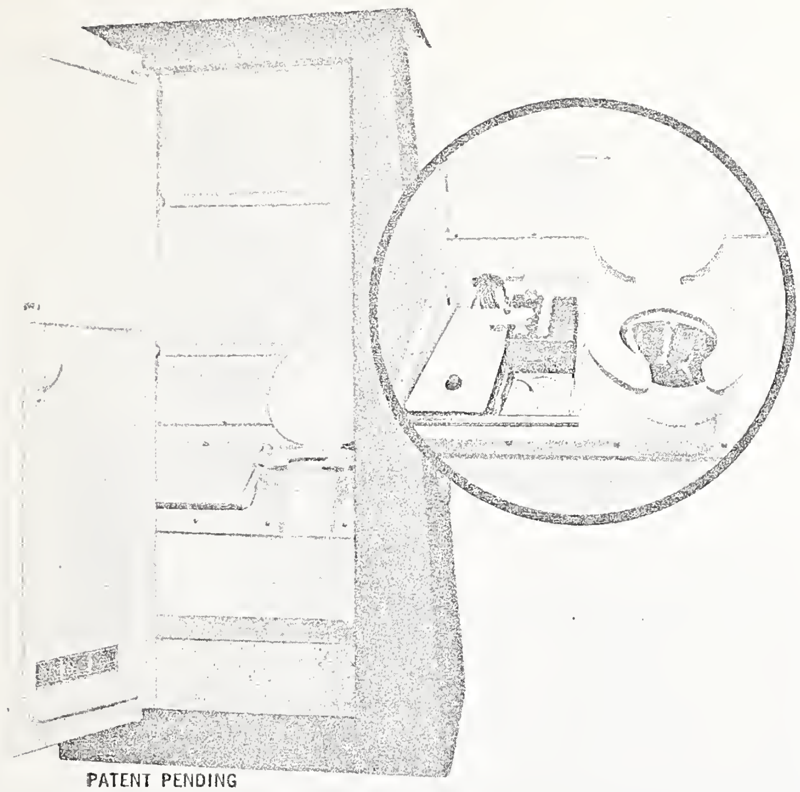
All moving parts are housed in locked compartments to prevent vandalism.

Four adjustable feet are provided to ensure the 1000M is level in all installations.

The Model 1000M may be ordered with:
(1) Discharge Valve (fits 3" closet flange); (2) Water Fill Valve and Vacuum Breaker Assembly (for use when water is available); (3) Monovolt Converter, Model 10A.
Battery is not included.



MODEL 1000FE



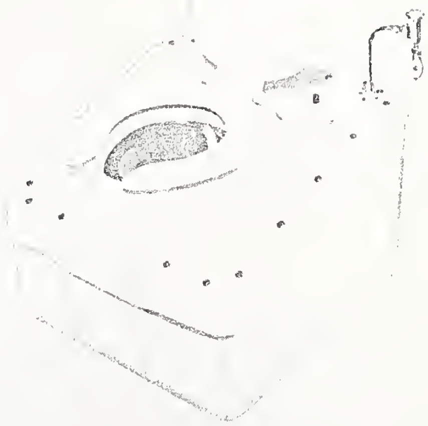
PATENT PENDING

The Model 1000 FE is the perfect sanitation system for any outdoor toilet application. This 1000-use facility can be used for beaches, golf courses, campgrounds, civil defense, agricultural locations, construction sites, parade routes — in fact, anywhere there is a large group of people.

Fully self-contained, the 1000 FE operates on a 12-volt DC battery or, when used with a Monovolt Converter Model 10A, on 110-volt AC. A 110-volt AC water-proof, electrical power connection permits plug-in of the entire system to a single outlet. All electrical and mechanical components are housed in the control module. All of these working parts are sealed under lock and key to prevent vandalism. The unique chemical dispensing system and a stack vent combine to assure positive odor control. The chemical reservoir automatically releases our MC-1000 chemical in the correct proportions. The stack vent is molded as an integral part of the cabinet. Rust-proof screening at the top of the cabinet, and louvered opening in the door provide additional effective ventilation.

Maintenance on the 1000 FE is simple. An initial charge of 12 gallons of water mixed with MC-1000 chemical is all that is required to prepare the unit for use. In a few moments the unit can be thoroughly cleaned inside and out — merely spray with a hose. The unit can be discharged quickly using either of two methods: (1) vacuuming by a service truck through the 6" service port, or (2) discharging by means of a factory-installed bottom discharge valve. Battery is not included.

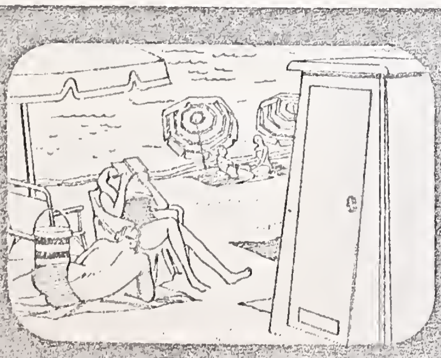
MODEL 160M

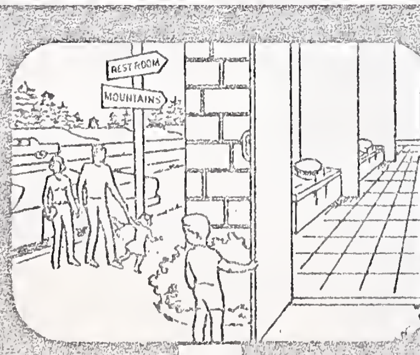


Looking for a modern, recirculating, electric, flushing toilet to service small groups or which requires a small space? The 160M is just right for you. It can be used in administrative trailers, job site offices, trains, ranger stations, buses as well as other applications. It has the capacity for 160 uses and is made of the same durable materials as the other Jet-O-Matics, stainless steel, plastic and fiberglass. The 160M requires an initial charge of 8 gallons of water mixed with MC-1000 chemical. When it is full it contains 16 gallons and can be emptied by simply releasing a built-in valve at the base of the unit. After a rinse it requires but a few minutes to recharge the unit. The 160M operates on: (1) a 12-volt DC battery, or (2) on conventional 110-volt AC when used in conjunction with the Monovolt Converter, Model 10A. Installation takes minutes. The unit fits on a 3" floor flange and requires two bolts to connect it to the floor.

This compact unit is self-contained and portable. Its size allows it to be installed almost anywhere. Four adjustable feet are provided to ensure the 160M is level whenever it is installed.

The Model 160M may be ordered with a Monovolt Converter Model 10A. Battery is not included.





SPECIFICATIONS:

MODEL 1000M

eight — (Empty)	78 Lbs.
mensions	33" high, 36" wide, 24" deep (mounted on leveling feet)
Usable Capacity	62 Gallons (Approx. 1000 usages)
lding Tank	Fiberglass
nk Cover	ABS Plastic
ilet Bowl	Stainless Steel
Toilet Seat	Plastic — Open Front
Filter Pump Assembly	ABS Plastic, Delrin and Stainless Steel
rrent Draw	9 Amps. maximum during 8 second flush
Automatic Chemical Dispenser	Plastic
isposal Outlets	Bottom discharge valve (fits 3" toilet floor flanges) 5" service opening on side (for use with vacuum truck)

stem operates on 12-volt DC — (Conventional 0-volt AC can be used with Monovolt 10A Converter.) Battery not included.

MODEL 1000FE

Weight — (Empty)	350 Lbs.
Dimensions	7'7" high, 3'8" wide, 4'2" Deep (Mounted on 4" X 4" X 4'6" Skids)
Usable Capacity	62 Gallons (Approx. 1000 usages)
Cabinet and Tank	Fiberglass
Tank Cover	ABS Plastic
Toilet Bowl	Stainless Steel
Toilet Seat	Plastic — Open Front
Filter Pump Assembly	ABS Plastic, Delrin and Stainless Steel
Current Draw	9 Amps. maximum during 8 second flush
Ventilation Screening	Plastic
Automatic Chemical Dispenser	Plastic
Disposal Outlets	Bottom discharge valve (fits 3" toilet floor flanges) 6" service opening on side (for use with vacuum truck)

System operates on 12-volt DC — (Conventional 110-volt AC can be used with Monovolt 10A Converter.) Battery not included.

MODEL 160M

Weight — (Empty)	28 Lbs.
Dimensions	19' high, 24" wide, 24" deep (mounted on leveling feet)
Usable Capacity	16 Gallons (Approx. 160 usages)
Cabinet and Tank	Fiberglass
Tank Cover	ABS Plastic
Toilet Bowl	Stainless Steel
Toilet Seat	Plastic — Open Front
Filter Pump Assembly	ABS Plastic, Delrin and Stainless Steel
Current Draw	9 Amps. maximum during 8 second flush
Disposal Outlet	Bottom discharge valve (fits 3" toilet floor flanges)

System operates on 12-volt DC — (Conventional 110-volt AC can be used with Monovolt 10A Converter.) Battery not included.

OW MANY DAYS OR HOW MANY PEOPLE WILL THE MODELS 1000FE & 1000M ACCOMMODATE?

EXAMPLE: 20 (60 uses daily) will use the 17 days before it requires servicing.

Surveys indicate that a public sanitation facility on location will be used by the average adult 3 times daily.

Average No. of Using Daily	5	10	15	20	25	30	35	40	45	50	60	80	100
No. of in Use Before Recharging	67	33	22	17	13	11	9	8	7	6	5	4	3

EXAMPLE: The can be used 11 before servicing when used daily by 30 people (90 uses daily).

The Model 160M has been designed for any application where a small number of people will be utilizing it, or, where there is only a limited amount of space available.

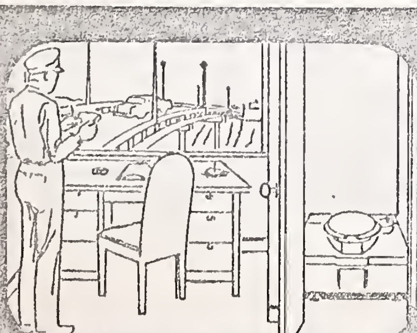
As an example, 8 people can use the 160M in an office trailer for one week.

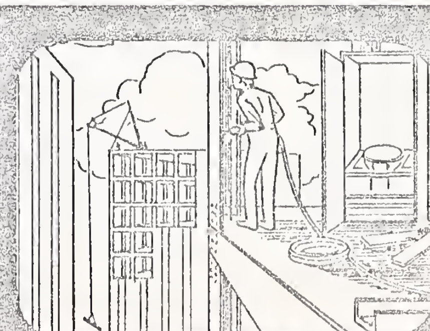
OPTIONS:

ottom Discharge Valve
Monovolt Converter Model 10A

ottom Discharge Valve
Monovolt Converter Model 10A
Water Fill Valve and Vacuum
reaker Assembly

Monovolt Converter Model 10A
OTE: On the Model 160 M
e Water Fill Valve-Vacuum
Breaker Assembly and Bottom
ischarge Valve are standard
quipment.





WOODALL'S® TRAILER TRAVEL TESTS THE MONOMATIC

Jerry Copeland

The Monomatic comes in two models, A and W. Both are self-contained, electrically operated recirculating, flushing toilets. They provide approximately 80 usages, and can be used independently or connected to a holding tank. Both models include a factory installed drain valve which is above the floor. The difference between the two models only has reference to the "charging" or "recharging". The Model A is manual filled and rinsed with a measured container, while the Model W connects directly to a water supply with a factory-installed rinsing and filling tube, water inlet fitting, anti-siphon vacuum breaker, and shut-off valve. After "charging", the operation of both models is identical.

The Monomatic was developed by Monogram Industries of Los Angeles and has been used for some time in Douglas DC8 and Boeing 707 jet airliners flying throughout the world. These same proven principles are now available to us for our recreational vehicles. Many manufacturers provide Monomatics in their trailers, motorhomes and campers as standard or optional equipment. For this test, we set out to find how the Monomatic lends itself to we "do it yourselfers" who are not equipped with any toilet or have one which is not satisfactory and should be replaced.

For this test, we installed a Monomatic in a pick-up camper that previously had a different type toilet with a holding tank built into the floor. The other unit was discarded, but the holding tank of 15 gallons capacity was retained.

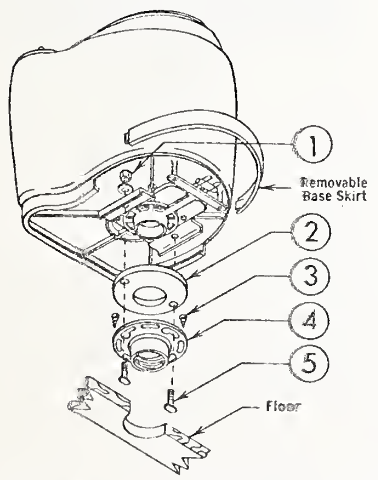
The Model W was used here, as the previous installation had water piped into it. The floor flange which fastens to the holding tank under the floor was re-used. The photograph shows how it looked at this stage. We took the wax floor flange seal which comes with the new

Model A: Manual filling and rinsing with a measured container.

Model W: Connects directly to water supply for easy rinsing and filling. Complete with factory-installed rinsing and filling tube, water inlet fitting, anti-syphon vacuum breaker, and shut off valve.

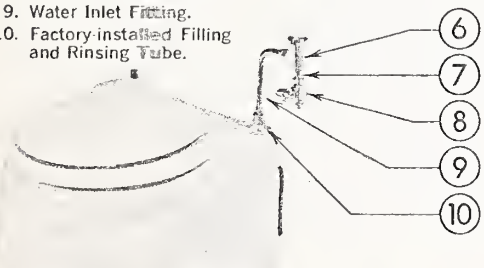
INSTALLATION PARTS LIST

1. $\frac{1}{4}''$-20 Mounting Nut and Washer.
2. Floor Flange Seal.
3. Wood Screws or other fastening devices—not supplied.
4. Standard 3-inch Cast Iron Floor Flange—not supplied.
5. $\frac{1}{4}''$-20 Solid Brass Closet Bolts.



ADDITIONAL PARTS MODEL "W" ONLY

6. Anti-syphon Vacuum Breaker.
7. $\frac{3}{8}$-inch Close Nipple.
8. $\frac{3}{8}$-inch Shut-off Valve.
9. Water Inlet Fitting.
10. Factory-installed Filling and Rinsing Tube.



unit and put it onto the flange and placed the Monomatic over the two bolts and fastened it down with the two nuts.

Should you be starting from scratch, the procedure would not be too much different. If you have a floor with no holding tank, go to a hardware store or plumbing shop and buy a standard, three-inch cast iron floor flange. All Monomatics come with a heavy cardboard template, and placing this on the floor will show you where to cut the hole for the flange. Cut a five inch hole and place the flange over it. Position the flange so that the closet bolts fit into it at 3:00 and 9:00 o'clock and fasten the flange to the floor with wood screws. Put the wax seal into the groove in the flange, set the Monomatic on it so that the closet bolts go through the mounting brackets in the base of the unit, and fasten with two nuts.

There are two electrical leads emerging from the rear of the Monomatic which must be connected directly as a separate circuit to your 12-volt direct current (or battery) supply. If these leads are not long enough, you must use #14 wire in the wire you add. The positive wire is tagged (+) and a fuse is already built into the motor chamber for motor protection.

At this stage, if we used the Model A, the installation would be complete. Since we have the Model W, we need to connect it to the camper water supply. From the previous installation, we have a ½ inch plastic pipe coming up through the floor. We connected this with ⅜ inch flexible plastic line and connectors to the shut-off valve. Had we not had water piped in already, we could have connected through the wall to a garden hose connection and had water available for rinsing and charging that way.

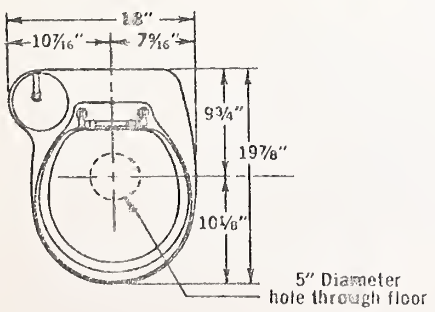
Now that we are all installed, how does it work? For the Model A, we pour in a measured amount of water — four gallons. For the Model W, we turn on the valve and let it run in. When it gets to the four gallon level, there is a distinct difference in the sound of the water running in and that is the signal to turn it off. Press the flush button and the pump will operate for a timed eight second cycle. As it is flushing, slowly add one package of Monochem T-5 chemical into the bowl. Flush several times in order to completely dissolve the chemical. Once the unit is charged, its remaining capacity will accommodate approximately 80 usages. No more water is added for flushing or is taken from your water supply.

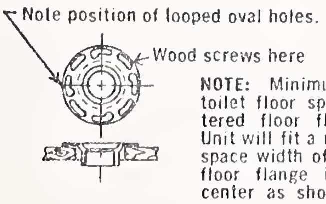
You will know it is time to empty when you see some water in the bottom of the bowl after flushing. If you are connected to a holding tank, you only have to remove the snap-on skirt at the bottom of the Monomatic, open the valve and let the contents run into the holding tank. Pour or run in some water to rinse and let that into the holding tank and you are ready to recharge. This type of installation can allow you to travel two or three weeks without having to find a disposal station. Even without a holding tank, 80 uses should serve the average family close to a week.

Conclusions reached in this test are all favorable. The Monomatic is especially suitable for the person who has a closet and would like to add a toilet. For him, it is instant plumbing. For other installations, it works equally well because it will install anyplace another toilet has been, and will work well with or without a holding tank.

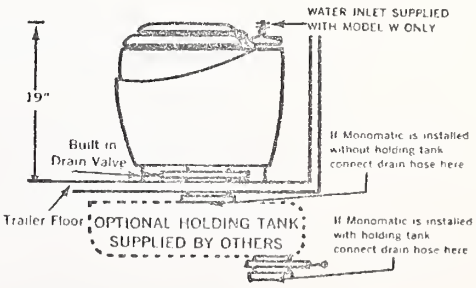
The Model A sells for $195.00 and the Model W for $220.00. They are available at practically every recreational vehicle dealer or you can contact Monogram Industries, Inc., 6357 Arizona Circle, Los Angeles, California 90045 for the name of the dealer nearest you.

THE MONOMATIC HAS STANDARD MOUNTING BRACKETS AND MAY READILY REPLACE ANY MARINE STOOL OR CONVENTIONAL HOUSEHOLD TOILET.

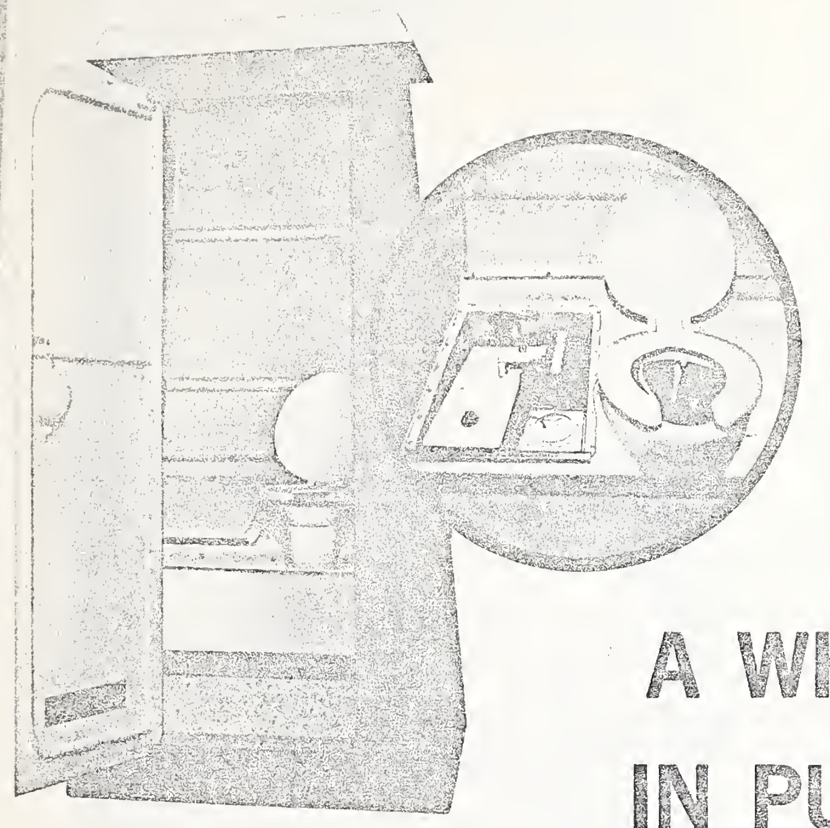




NOTE: Minimum width of toilet floor space with centered floor flange is 22". Unit will fit a minimum floor space width of 18" provided floor flange is placed off center as shown in Fig. B.



MODEL A AND MODEL W MAY BE INSTALLED WITH OR WITHOUT HOLDING TANK.
When used with holding tank the capacity of self containment is extended beyond 80 usages.



MODEL 1000FE
PATENT PENDING

Jet-O-Matics... A WHOLE NEW WORLD IN PUBLIC SANITATION

When Monogram Industries embarked on its public sanitation development program, the company realized what a vast area it was entering. The many applications had to be provided for—but how?

The decision was to produce a series of products that would allow for sanitation no matter what requirements existed. Could we install a Jet-O-Matic in an existing structure? How could we utilize Jet-O-Matics in new building plans? Could we put them in mines? on ski slopes? beaches? golf courses? What about high rise construction? Could Jet-O-Matics be used for small groups as well as large? Would they be applicable in isolated locations? What problems would the power source create?

Many questions indeed! Let's look at these products—one by one.

The Jet-O-Matic Model 1000 FE had its baptism on a posh golf course in the Palm Springs, California, region. Members and guests were delighted to find this recirculating flushing toilet by the 5th tee. Many favorable comments were heard in the vicinity of the beautiful, blue and white fiberglass mini-building.

Soon, other placements put the unit with its stainless steel bowl to use. The U.S. Department of Agriculture Forest Service, the U.S. Department of Interior Park Service and the U.S. Army Corps of Engineers found it advantageous to place these units with built-in automatic chemical dispensers in recreation areas, since they provided positive odor control during the more-than-1,000 use cycle. The interior and exterior of the unit offered low maintenance and was easily spray-cleaned.

By putting all the working parts in a locked compartment, as well as providing a lock on the door, vandalism was discouraged. Government officials at all levels are delighted to note that the toilet holding tank discharges only 60 gallons of effluent compared to the 3,000 to 8,000 gallons required by conventional equipment.

Officials at the Sanford Recreation Area, Texas, found their Jet-O-Matic outdoor unit so worthwhile, the call went out for a similar unit that could be used

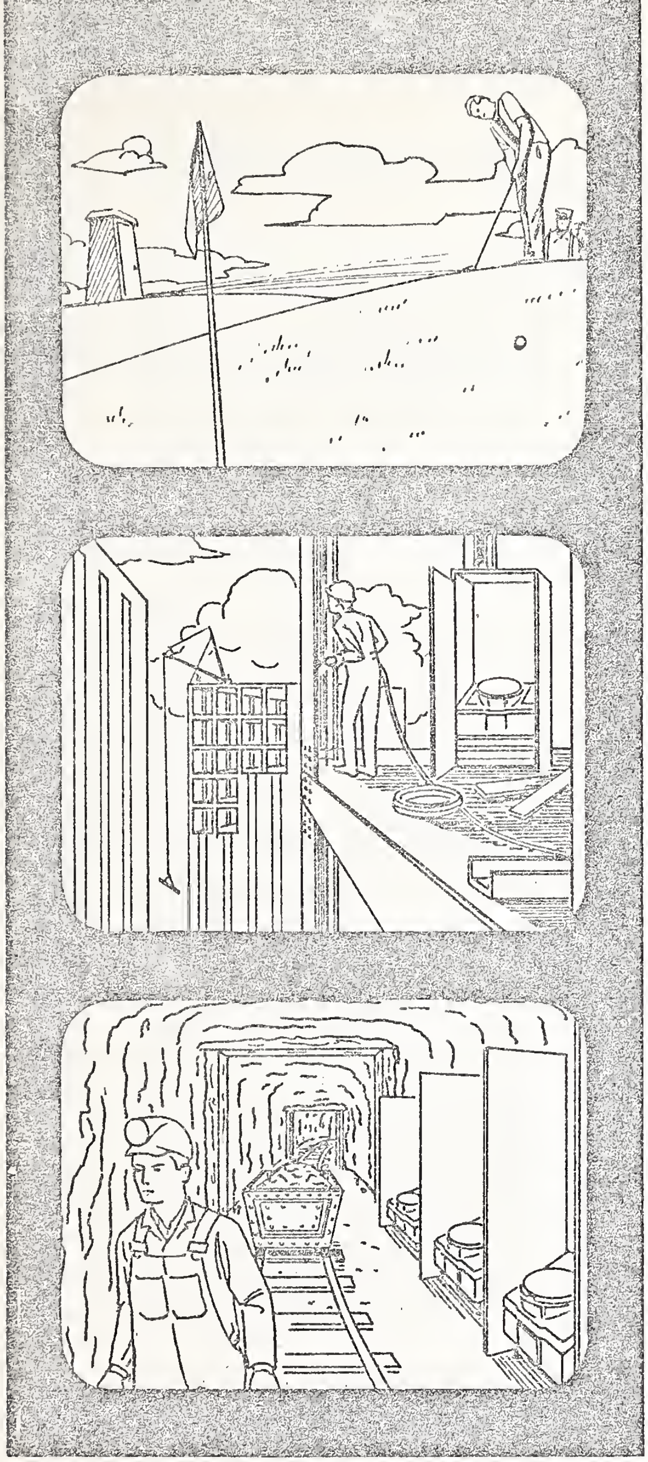
HOW MANY DAYS OR HOW MANY PEOPLE WILL THE Jetomatic MODELS 1000FE & 1000M ACCOMMODATE?

EXAMPLE: 20 PEOPLE (60 uses daily) will use the JET-O-MATIC 17 days before it requires servicing.

Surveys indicate that a public sanitation facility on location will be used by the average adult 3 times daily.

Average No. of People Using Jetomatic Daily	5	10	15	20	25	30	35	40	45	50	60	80	100
No. of Days in Use Before Recharging	67	33	22	17	13	11	9	8	7	6	5	4	3

EXAMPLE: The JET-O-MATIC can be used 11 DAYS before servicing when used daily by 30 people (90 uses daily).



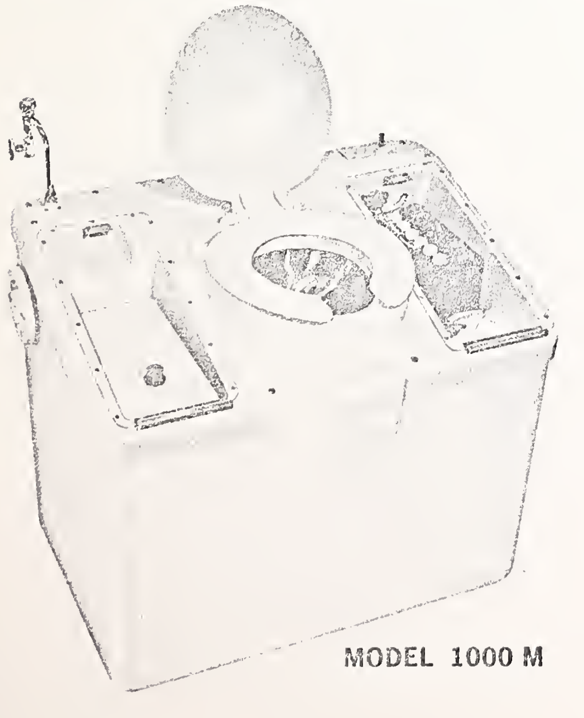
in mobile comfort stations. Monogram responded with their Model 1000 M. This modular unit, while combining all the features of the Jet-O-Matic outdoor toilet, can be placed in existing structures or new buildings. At Sanford, patrons now use two mobile comfort stations both of which are equipped with five Jet-O-Matic modules. Each module requires a simple 12-gallon charge and is discharged after every 1,000-use cycle into a 600-gallon holding tank. A 300-gallon frēsh water tank provides clean water for washing.

The Forest Service has installed six Jet-O-Matic modules in the Visitors Information Station in the El Dorado Forest, California. These discharge into a large holding tank which can be emptied once a year.

A mining company in Colorado is planning to install 20 units in their shafts high in the Rockies.

In addition to these large volume applications, there has been a demand for units of smaller capacity. Monogram's Jet-O-Matic Model 160 M has been installed in many existing Forest Service buildings, replacing vault toilets designed to accommodate one person at a time. This unit, like all Jet-O-Matics, features the same stainless steel bowl used in jet aircraft and has a fiberglass holding tank with a capacity good for 160 uses. Several builders of commercial office trailers have included this toilet in their units. Due to its lower capacity, the chemical dispenser is not required. The solution is poured into the unit when it is charged.

Increased leisure activity, population growth and expanded construction programs have increased the pressure on our existing public sanitation facilities. The demand for upgraded sanitation has become more and more insistent. The Jet-O-Matic series is the most dramatic step taken to meet that demand.



MODEL 1000 M

MODEL 160 M

S. H. Comm.—Form 4 A

INTER-DEPARTMENTAL MEMORANDUM

STATE HIGHWAY COMMISSION OF MONTANA

To Grover O. Powers, P.E., Preconstruction Engineer — Date June 30, 1970

From Lehman B. Fox, P.E., Materials Engineer — Subject: Great Falls-North Rest Areas

In response to your request of June 5, to investigate a well at the weight station one mile south if the Vaughn exit, we have found it to be totally unsatisfactory as a rest area water supply.

We were unable to run a pump test as the wellhead is apparently buried beneath the fill. However, a chemical analysis found this water to contain 4,130 PPM total solids (see accompanying report) and to be highly corrosive and definitely encrusting to metal.

This water is presently used for flushing the toilet only. The men carry their own drinking water. Its encrusting nature is obvious in the taps.

It is our opinion that a similar water source could be obtained on the other side of the road, but of similar poor quality. The water is probably coming from alluvial material in contact with bedrock shale (the source of the dissolved solids) or bedrock itself.

We know of no purification system which could remove the large amount of dissolved solids in the volume of water required by a public rest area. From our experience this water would also not be usable for irrigation.

LBF/DAW/DRW/lch

cc: B. B. Briscoe/Gt. Falls/W. Attach.
L. B. Fox
Lab. File /W. Attach.
Geol. File

Date Recd. Preconst. 7-1-70

MAIL ROUTE

	30 GOP RMH	30 Field Design	30 Surfacing Design	31 Office Engineers	32 West Region	32 Landscape	33 East Region	34 Hydraulic	35 Urban	36 Traffic	37 Pub. Hearing	38 Sec. Roads	39 Consultant Design		File
Initial															
Attach															
Info					✓										✓
Act															

[illegible signature]

Avoid Verbal Instructions

LAB. FORM NO. 45
REV'D 5-56

GAZETTE

STATE HIGHWAY COMMISSION OF MONTANA

Helena, Montana

FORM TO ACCOMPANY MISCELLANEOUS SAMPLES SENT FROM FIELD

Helena Lab. No. 392705 Project No. I-15-5(11) 283

Designation of Project Vaughn-Cascade - Teton Co. Line

Date Sample Rec'd 6/26/70 Field No.

Name of Material Water sample from well at weigh station

Grade or Type ~~Trade Name~~ one mile south of Vaughn exit

Manufacturer of Material

Jobber or Dealer Directly Supplying Material Montana Highway Commission

Quantity of Material Sample Represents

If this is a check or resample, please indicate ---

Name of Sampler D. Wilke Title Geologist

Address Helena Lab. Date of Sampling 6/25/70

Use this FORM ONLY when other Forms are not already provided.

Remarks for chemical analysis

pH = 7.4

CO_2 = None

Phenolthalein Alkalinity = 10 ppm

Methyl Oraange Alkalinity = 433 ppm $CaCO_3$

Total Solids = 4,130 ppm

Total Hardness = 1,728 ppm

Conductivity = 5.5 m. mhos.

Sodium = 1,638 ppm

Water is highly corrosive to metal

Water is definitely encrusting to metal.

T. 21N R. 2 E

County Cascade

MONTANA BUREAU OF MINES AND GEOLOGY

Butte, Montana

WATER WELL LOG

Owner: Montana Highway Department Address: Helena, Montana

Driller: E. A. Holman Address: 601 Pine Spokane, Wash.

Date Started: January 28, 1960 Date Completed: Febuary 2, 1960

Location: Sec. 28 T. 21 N R. 2 E 1/4 sec. NE

Section 28

Highway Sta. 1069+93.2 128.7' Lt. D I 15-5 (9) 275 Unit 1

Type of well: Drilled (Dug, driven, bored, or drilled) Equipment used: Rotary drill (Churn drill, rotary, other)

Water use: Domestic ☐ Municipal ☐ Stock ☐ Irrigation ☐

Industrial ☐ Drainage ☐ Other: Public Wash Room Facilities

Casing: 5 ft. to 86 ft. Type Cast Iron Size 6"

Casing: ft. to ft. Type Size

Casing: ft. to ft. Type Size

* Perforated or Screened: Ft. 73 to ft. 84 Ft. to ft.

* Type of screen or perforations: Cut with torch 1" by 1/400 per ft.

* Static Water level, for non-flowing well: static water level 68 ft. feet.

* Shut-in pressure, for flowing well: lb./sq. in. on: (date)

Pumping water level 68 feet at 22 gal. per min.

How tested: Bailer

* Length of test 6 hrs.

Remarks: (Gravel packing, cementing, packers, type of shut-off, depth of shut-off)

2 foot gravel pack at bottom of casin

(over)

Log of Well

Depth, feet From	Depth, feet To	Description of Material Drilled
0	15	Fill
15	75	Shale (gray)
75	86	Sand & Gravel
86	[illegible]	Quick sand

STATE OF MONTANA, } ss.
County of Cascade }

I hereby certify that the within instrument was filed in this office on the 17 day of FEB 17 1961 at 4 o'clock P M.

J. L. Lemmons
County Clerk and Recorder.

By [illegible] Deputy.

S. H. Comm.—Form 4 A

INTER-DEPARTMENTAL MEMORANDUM

STATE HIGHWAY COMMISSION OF MONTANA

To Grover O. Powers, P.E., Preconstruction Engineer

Date June 22, 1970

From Lehman B. Fox, P.E., Materials Engineer

Subject: I-15-8(5)
Toole Co. Line North
Prospect Well for
Rest Area Site

Investigation for water sources at the designated areas (see attachments) has been completed.

Prospect Hole No. 1 showed an inadequate and too shallow an aquifer (½ gallon per minute at 8.0' depth). If a rest area is desired at this site, the water supply will have to be pumped to it from the vicinity of prospect Hole No. 2.

Prospect Hole No. 2, showed an adequate, uncontaminated water supply. The well was pumped 1.5 hours and provided 25-30 gallons per minute. No fine sand or silt was in evidence during pumping.

However, because of the relative shallowness (16-19') of the supply, to prevent contamination from flood waters, the permanent well should be constructed on a filled area of approximately 15 feet in height and surrounded with a concrete slab or cap. This will put the well depth (supply) at 30' plus. To insure a constant supply, the well depth should be at least 50' from natural ground.

The water supply in Hole No. 2 has been passed by the State Board of Health and according to the State Laboratory, the water is non corrosive but may be slightly incrusting.

Copies of their reports are attached.

Date Recd. Preconst. 6-23-70

MAIL ROUTE	Initial	Attach	Info	Act
30 GOP | RMH				
30 Field Design				
30 Surfacing Design				
31 Office Engineers				
32 West Region				
32 Landscape				
33 East Region				
34 Hydraulic				
35 Urban				
36 Traffic				
37 Pub. Hearing				
38 Sec. Roads				
39 Consultant Design				
File				

LBF/DAW/EWM/lch

cc: D. Gruel, Hydraulics Engr./Attach.
L. B. Fox
Lab. File
Geol. File

Lehman B. Fox

Avoid Verbal Instructions

STATE HIGHWAY COMMISSION OF MONTANA
HELENA, MONTANA

REPORT ON MISCELLANEOUS SAMPLE

Lab No. 391920 Sample No. 2 Project No. I-15-8 (5)

Designation of project Toole Co. Line N. - Prospect Well for Rest Area

Kind of material Water

Name and address of manufacturer Geology Dept.

Name and address of jobber

Submitted by E. W. Mayberry Title Geologist II

Address Quantity represented

Date submitted 9-11-70 Date received 6-12-70

TEST RESULTS

pH = 7.2

CO_2 = 33 ppm

Phenolthalein Alkalinity = None

Methyl Orange Alkalinity = 234 ppm $CaCO_3$

Total Hardness = 296ppm $CaCO_3$

Water is not corrosive, but is slightly incrusting.

Materials Engineer

Date Reported June 22, 1970

RECD JUN 16 1970

State of Montana

State Department of Health

JOHN S. ANDERSON, M.D.
EXECUTIVE OFFICER

HELENA, MONTANA

June 15, 1970

Highway Department
Geology Department
Cogswell Building

Laboratory No. 4719
Field No. 1114
Collected: Date 6-9-70 Town Shelby, Marias River
County Toole Sample from cistern
Owned by St. Prospect Well
Collector Geology Department
P. O. Address Helena

Reference is made to the above sample of water submitted to our laboratory.

The laboratory examination of this sample showed no evidence of contamination. This indicates that, as far as can be determined by a laboratory examination, the water was safe for drinking at the time the sample was taken. However, these results cannot be relied upon as indicating the safety of the water at all times unless the source is properly located and maintained.

Any well construction which does not positively exclude all surface and subsurface contamination must be considered as dangerous to health.

All dust, pump spillage, surface drainage, bird droppings, scrapings from one's shoes, etc., must be prevented from entering the well.

This examination does not include tests for hardness, minerals, iron, fluorides, etc. nor does it include tests to determine suitability for irrigation or for stock purposes.

sd/11

Yours very truly,

Claiborne W. Brinck

Claiborne W. Brinck, Director
Division of Environmental Sanitation

cc: Michael Barton, M.D., County Health Officer, Shelby
CWB:mg
E.S. No. 15

REC'D JUN 16 1970

State of Montana

State Department of Health

JOHN S. ANDERSON, M.D.
EXECUTIVE OFFICER

HELENA, MONTANA

June 15, 1970

Highway Department
Geology Department
Cogswell Building
Helena, Montana 59601

Laboratory No. 4720
Field No. 1115
Collected: Date 6-9-70 Town Shelby
County Toole Sample from not stated
Owned by not stated
Collector Geology Department
P. O. Address

Reference is made to the above sample of water submitted to our laboratory.

The labo ory examination of this sample showed no evidence of contamination. This indicates that, as far as can be determined by a laboratory examination, the water was safe for drinking at the time the sample was taken. However, these results cannot be relied upon as indicating the safety of the water at all times unless the source is properly located and maintained.

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sd/11

Yours very truly,

Claiborne W. Brinck

Claiborne W. Brinck, Director
Division of Environmental Sanitation

cc; Michael Barton, M.D., County Health Officer, Shelby
CWB:mg
E.S. No. 15

RECD JUN 16 1970

THE GREAT SEAL OF THE STATE OF MONTANA

State of Montana

State Department of Health

JOHN S. ANDERSON, M.D.
EXECUTIVE OFFICER

HELENA, MONTANA

June 15, 1970

Geology Department
Cogswell Building
Helena, Montana 59601

Laboratory No. 4721
Field No. 1117
Collected: Date 6-9-70 Town Shelby
County Toole Sample from St. Prospect well
Owned by St. Prospect well
Collector Geology Department
P. O. Address Helena

Reference is made to the above sample of water submitted to our laboratory.

The laboratory examination of this sample showed no evidence of contamination. This indicates that, as far as can be determined by a laboratory examination, the water was safe for drinking at the time the sample was taken. However, these results cannot be relied upon as indicating the safety of the water at all times unless the source is properly located and maintained.

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sd/11

Yours very truly,

Claiborne W. Brinck

Claiborne W. Brinck, Director
Division of Environmental Sanitation

cc: Michael Barton, M.D., County Health Officer, Shelby
CWB:mg
E.S. No. 15

State of Montana

State Department of Health

JOHN S. ANDERSON, M.D.
EXECUTIVE OFFICER

HELENA, MONTANA

June 15, 1970

Geology Department
Cogswell Building
Helena, Montana 59601

Laboratory No. 4722
Field No. 1116
Collected: Date 6-9-70 Town Shelby
County Toole Sample from cistern
Owned by State Prospect well
Collector Geology Department
P. O. Address Helena

Reference is made to the above sample of water submitted to our laboratory.

The laboratory examination of this sample showed no evidence of contamination. This indicates that, as far as can be determined by a laboratory examination, the water was safe for drinking at the time the sample was taken. However, these results cannot be relied upon as indicating the safety of the water at all times unless the source is properly located and maintained.

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Yours very truly,

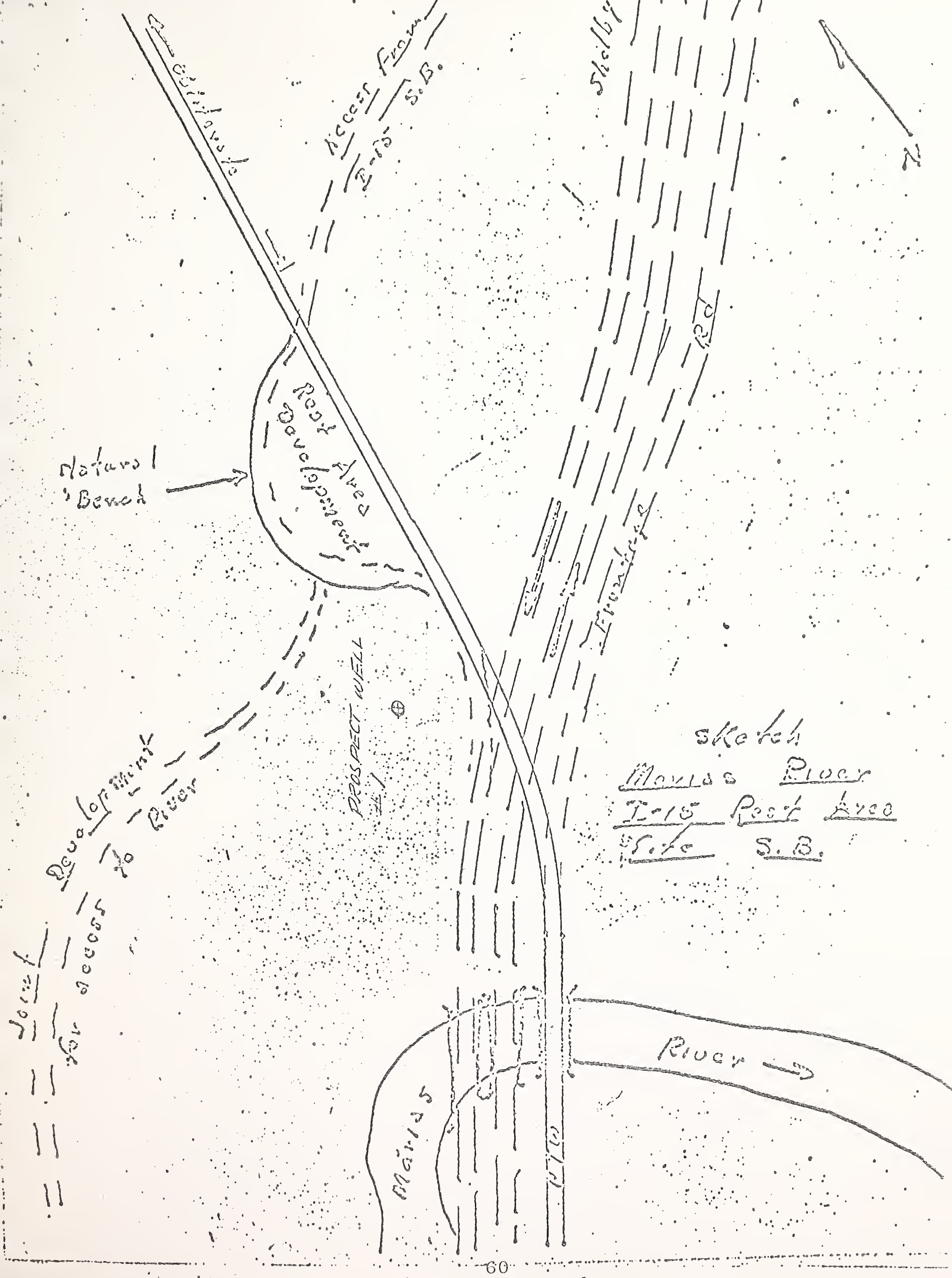
Claiborne W. Brinck

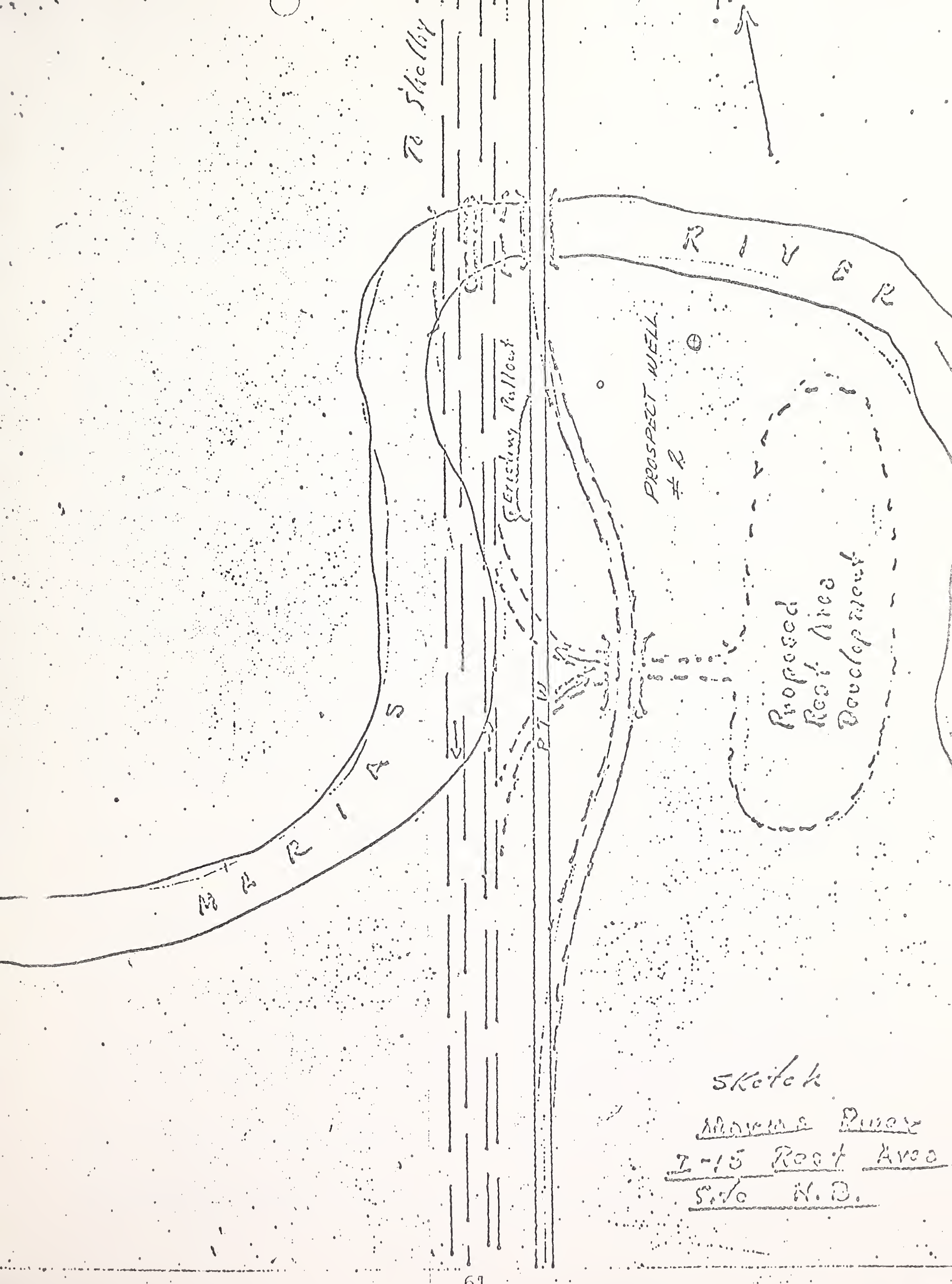
Claiborne W. Brinck, Director
Division of Environmental Sanitation

sd/11

cc: Michael Barton, M.D., County Health Officer, Shelby

CWB:mg
E.S. No. 15


Access From I-15 S.B.
Shelby
N
Rd
Rest Area Development
Natural Bench
Frontage
PROSPECT WELL #1
Joint Development for access to River
Sketch
Marias River
I-15 Rest Area
Site S.B.
River
Marias


To Shelby
MARIAS RIVER
Existing Pullout
PROSPECT WELL #2
Proposed Rest Area Development
Sketch
Marias River
I-15 Rest Area
S/o N.B.

G.O. Powers, P.E., Preconstruction Engineer — March 12, 1970

S.C. Kologi, P.E., Regional Engineer, West — Rest Area Review

The following people met in Great Falls, March 9 & 10 to make a review of possible rest area sites sbetween Great Falls, and Sweetgrass:

Eric B. Erickson,	District Engineer	Bureau of Public Roads
Irvin Loyd,	Regional Landscape Architect	Bureau of Public Roads
Dan Larsen,	Area Engineer	Bureau of Public Roads
Ben B. Briscoe,	DistrictEngineer	Montana Highway Commission
Gene H. Larson,	Area Engineer	Montana Highway Commission
Ken Chrest,	Landscape Designer	Montana Highway Commission
Charlie Clark,	Geologist	Montana Highway Commission

Various sites were discussed and looked at and a brief report of each follows:

There is a possible site at the Vaughn Interchange with a possible water supply from Vaughn. This site isn't the best because of the run down and junky area, but it was felt that it could be landscaped and screened to provide adequate facilities.

Other areas were looked at over the next 10± miles but water would have to piped or hauled into them. It was estimated that water would have to be piped from 1 to 2 miles.

If it were feasible to pipe the water into these areas, a site about 2 ± miles south of Power would be the best suited as a rest area. The Interstate Highway will cut through a shelter belt which could be developed into rest areas on each side. It was pointed out that some of the trees will have to be taken out for highway construction and could be transplanted in the rest area. The frontage road would have to be relocated on the west in order to provide room.

The Power water supply could possibly be used in the area between the Power Interchange and the separation 2± miles north of Power. There were no specific sites located in this area.

The proposed rest area at the Teton River crossing was discussed briefly. It was thought that a rest area on each side of the highway would be the best if it could be worked into the design.

The rest area sites north of Conrad were looked at. These were deleted because of lack of water. It was indicated that water could possible be obtained from the Air Force water line. However, we have correspondence from the Air Force stating that their policy is that no individual organization or agency shall be allowed to tap on the Government utility line, supporting a defense installation. There didn't appear to be any other water sources from here to the Marias River.

Two possible sites were reviewed at the Marias River. It appears that water would be no problem here plus the fact that this is a natural place for a rest area.

One site that was picked is east of the highway and south of the river which would serve northbound traffic only. The frontage road would have to be revised to

(CON'T)

make room for a rest area and would limit the size. The idea of using a structure over the frontage road and placing the rest area east of it was also discussed.

The other site at the Marias river is located on the present highway loop that will be abandoned after the Interstate is completed. It is located north of the river ½± miles and west of the highway and would serve southbound traffice only. The present highway could be used as the ramps on and off the Interstate with minor revisions. It was thought that hiking trails could be developed and possible a campground and other facilities could be developed with the Fish and Game Department.

There were no other new sites located but some discussion was given to the rest area north of Shelby, which is partially completed. Water is not available at this rest area. It was suggested that maybe chemical toilets could be used with possibly drinking water hauled and stored in a cistern. It appears that the ramps should be revised at this rest area.

The idea of chemical toilets and cisterns could possibly be used at other sites that were picked if suitable water could not be found.

The Bureau of Public Roads indicated that they would send us recommendations as to what sites they feel should be used that would best serve the traveling public and would fit into the area.

32-SCK:EHL:md

Stephen C. Kologi, P.E.,
Regional Engineer, West

cc: B.B. Briscoe
L.B. Fox (Attention Charlie Clark)
W.J. Schweyen
D.D. Gruel
E.H. Larson

Form FHWA-121 (12-67)

UNITED STATES GOVERNMENT

Memorandum

HELENA, MONTANA

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
~~Bureau of Public Roads~~

DATE: April 13, 1970

In reply refer to: 08-24.2 DA3

TO : State Highway Commission
Helena, Montana 30:GOP

FROM : H. N. Stewart, Division Engineer
Helena, Montana

SUBJECT: Montana I-15 between Great Falls and Sweet Grass
Rest Area Field Review, March 9 and 10, 1970

Recently rest area facilities about three miles north of Conrad and rest area facilities on the Shelby-Oilmont section of Interstate have been deleted from the highway planning because of lack of water. Because of this, we became quite concerned about the shortage of rest areas on I-15 between Great Falls and the Canadian Line, and we requested Mr. I. C. Lloyd our Regional Landscape Architect to accompany us on a field evaluation of potential rest area sites. Mr. Lloyd has furnished a report on the results of the inspection indicating potential sites and priorities for planning.

We concur with the recommendations listed in Mr. Lloyd's report. In addition our comments follow:

During the inspection Mr. Briscoe has indicated Muddy Creek south of Power might be a potential source of water for possible rest area facilities in this area. We suggest the feasibility of using this source be investigated. Evidently, some drilling has been done in search of water for planned rest area facilities south of Power and no water was encountered; therefore, the rest area was abandoned.

Please note Mr. Lloyd's report includes comments on the Teton River rest area facility. Mr. Lloyd recommends, and we concur, that a study of providing two separate rest areas be made in lieu of the planned single rest area site to serve both directions of travel. As the Interstate is presently under design, we suggest immediate attention be given to the possibility of providing two separate rest area facilities.

We would appreciate your review of the rest area comments and your comments on the future rest area planning that you might pursue.

Form FHWA-121 (12-67)
UNITED STATES GOVERNMENT

Memorandum

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
222 S. W. Morrison Street
Portland, Oregon 97204

TO : Mr. H. N. Stewart
Division Engineer
Helena, Montana

DATE: March 13, 1970

In reply refer to: 08-00.36

FROM : I. C. Lloyd
Chief, [illegible] Beautification Division
Portland, Oregon

SUBJECT: Montana I-15 between Great Falls and Sweet Grass
Rest Area Field Review, March 9 and 10, 1970

On March 9 and 10, I made an on-site rest area review on Interstate 15 between Great Falls and Sweet Grass with FHWA District Engineer Erickson and Area Engineer Larson; Montana SHD District Engineer Ben Briscoe, Area Engineer Eugene Larson and Landscape Designer Ken Chert. As a group, we reviewed various sites between the above points with the following criteria in mind:

<u>AASHO</u>

Public indicators where they desire location
20-30 mile spacing
Inviting site
Shelter from climatic elements
Availability of drinking water
Availability of power and telephone lines
Placement of comfort station and tables
Utilization of natural resources

<u>FHWA</u>

Fitting the development to the surrounding environment
Preservation and utilization of natural, manmade and cultural resources
Evacuation sites for emergency medical service by helicopter where possible

With the above criteria in mind, we reviewed the following possible sites:

1. Westbound and eastbound weigh stations approximately six miles west of Great Falls

   a. Water, power and telephone available
   b. Partial exposure to prevailing winds
   c. Would require reconstruction of ramps to and from scales and considerable grading
   d. Would serve travelers prior to their decision to continue travel on I-15 or on US89 (Vaughn Junction) or prior to

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their arrival in Great Falls; or a place for travelers to orient themselves on best route for westbound travel

2. Approximately one mile prior to Vaughn Junction, for westbound traffic

   a. Power and telephone available
   b. Partial exposure to prevailing winds
   c. Water availability questionable
   d. Would require considerable grading
   e. Would serve travelers prior to decision making -- use Junction I-15 or US89?

3. Vaughn Junction, northwest quadrant

   a. Water, power and telephone available
   b. Exposure to prevailing winds
   c. Would require redesigning ramps and frontage road
   d. Would require considerable grading
   e. Vaughn does not provide the best view from the highway
   f. Would serve southbound I-15 traffic or perhaps eastbound traffic on US89

4. Power, south of interchange

   a. Power and telephone available
   b. Water appears not to be available

   For drinking water, suggest a cistern be installed with an electric pump. It appears this is the system adjacent ranchers use.
   Suggest that instead of flush comfort stations, chemical toilets be used with a 2-3 day cleaning provision during the summer and once a week during the winter. Understand that the U.S. Forest Service has used a design similar to that used on jet aircraft; we have requested information on this which we will forward upon receipt.

   c. Utilize existing shelter belt for both directions of traffic. Additional windscreen will be needed which can be supplied by moving an 8-foot high plant material in the following procedure:

   (1) Conduct a careful study to determine prevailing winds and focus sights to good views.

   (2) Source of material can perhaps be found on abandoned farmsteads and by utilization of materials that would have

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to be moved for the Interstate motor road.

(3) Conduct force account planting by the supervision of an individual knowledgeable in horticultural practices.

(4) After sources have been located, open up ditch 3 feet deep to within 2½-3 feet of plant on both sides by November 15. Break plants loose but do not remove.

(5) Dig holes or open up a trench 2½ feet deep approximately 5 feet wide at planting site.

(6) Approximately March 10, while ground is frozen, break plant loose which will have attached ball.

(7) Once plant is placed in hole it will settle in place and very little watering should be needed.

(8) If plant is 8 foot, trim back to 6.

(9) This system should provide shelter, so user can get benefit while facility is relatively new.

d. Would serve travelers approximately 18 miles or more out from Great Falls.

e. Present PTW to be converted to frontage road would have to be relocated around west side of southbound site.

5. Teton River

a. Current plan is to develop only one site
b. Believe study should be made for sites to serve both directions of traffic
c. Power, water and telephone available
d. Good protection from climatic elements
e. River is a natural resource that is inviting to user
f. Sites can be seen from top of plateau from both directions
g. It is approximately half way between Vaughn and Conrad

6. Marias River, northbound

a. Existing traveled way has a roadside pullout with indication of high use
b. Water is available and there will be water supply source from river
c. Power and telephone available

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d. Site can be seen from plateau on south as user approaches
e. Access may be a problem, but as a suggestion see the attached sketch
f. River is a natural resource inviting to user
g. Access may be adverse to use of truckers since it is at bottom of vertical curve on the motorway

7. Marias River, southbound

a. Utilization of portion of existing PTW and natural bench
b. Good joint development potential for access to river with campground and picnic facilities (see sketch). Possible participation with Fish and Game Commission
c. Water available and there will be water supply from river
d. Power and telephone available
e. River is a natural resource inviting to user
f. Access out would be beneficial to truckers since it is downgrade toward river bridge

8. Eight miles north of Shelby, southbound traffic

a. This site has been developed as a first stage, with no water, power or phone and minimal comfort station facilities
b. Based on recent memorandum, update ramps and salvage as much of current development as possible
c. Power is available
d. Telephone source needs investigation
e. Provide water and comfort station facilities as stated in above 4,b
f. Provide one or two picnic table units
g. Provide a shelter belt by method described in 4,c above
h. Would serve southbound traffic from Canada. Considerable indication this site is being used

Since the distance between Great Falls and Shelby is approximately 84 miles, and as a suggestion and recommendation, we believe the sites should be considered with the following priorities in mind:

First Priority

1. Teton and Marias River

   Sites have available natural resources and other required criteria.

2. Eight miles north of Shelby, salvage an existing facility and provide service for southbound traffic from Canada.

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Second Priority

1. Power sites

As the distance between Great Falls and the Teton River is approximately 42 miles, the site would relieve the pressure on Teton River installations.

Third Priority

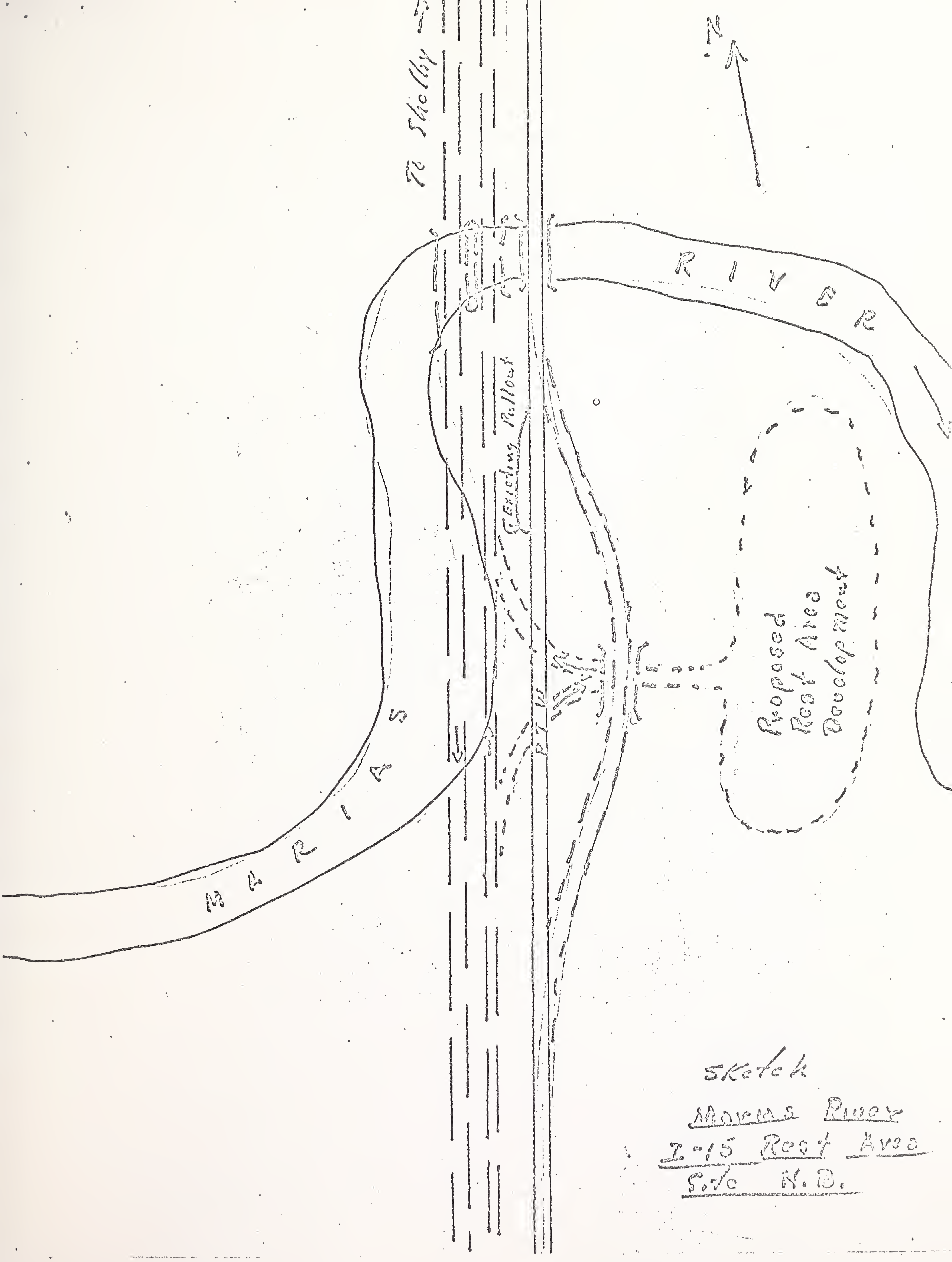
The group felt that a site should be considered between Great Falls and Vaughn Junction, but due to proximity of the interchanges it is rather difficult to determine a desirable site between these two points. That is why we looked at the weigh stations and a site approximately one mile east of Vaughn Junction. Regardless, we believe it would be very helpful to orient the traveler by having a facility between these two points, prior to Great Falls, with perhaps a Tri-vel facility similar to the one on the westbound lanes of US89 east of Great Falls between the city limits and Malmstrom AFB. This would help the traveler in deciding upon the best route through Great Falls and provide him with the necessary road traveler facilities.

Fourth Priority

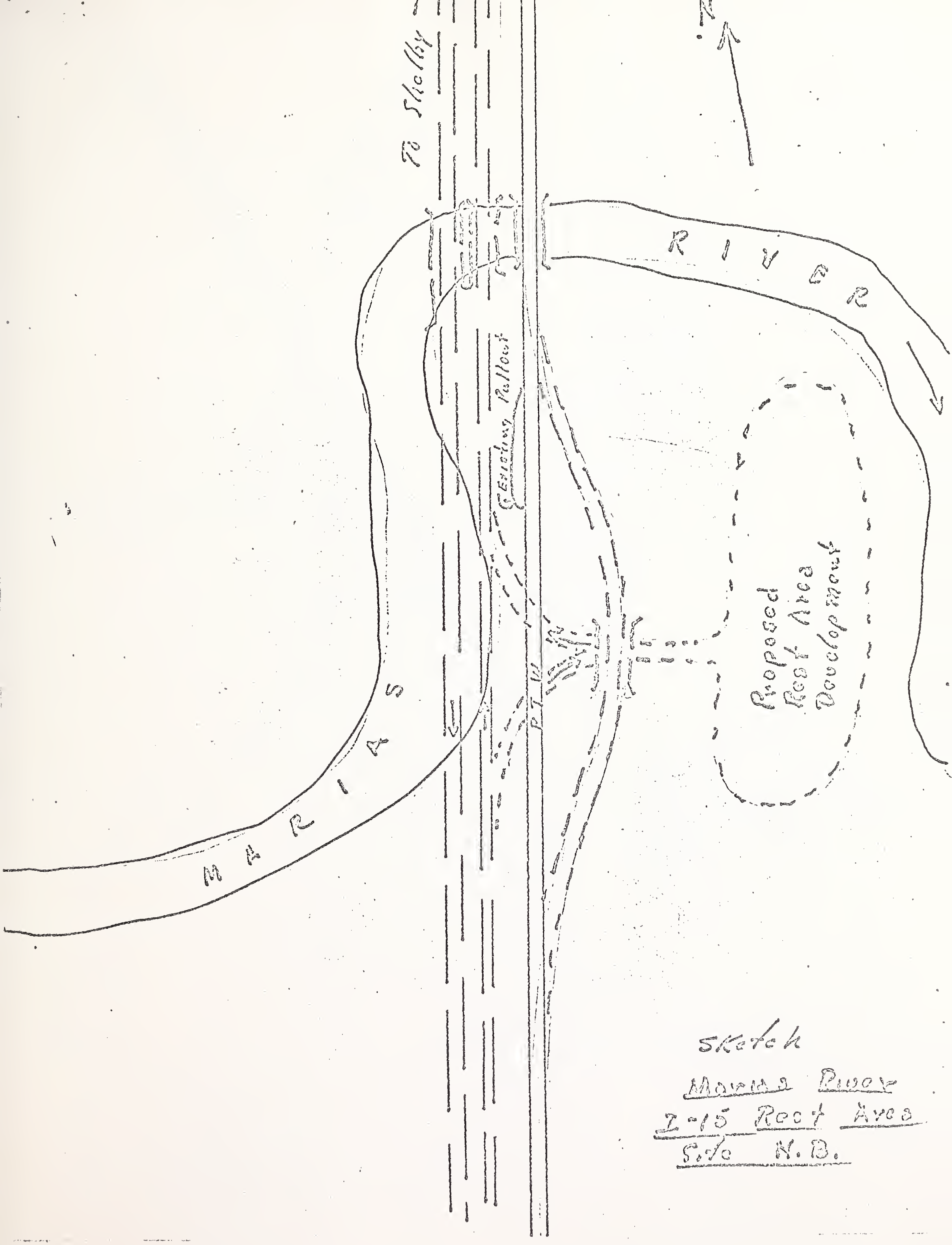
1. Site reviewed at Vaughn Junction

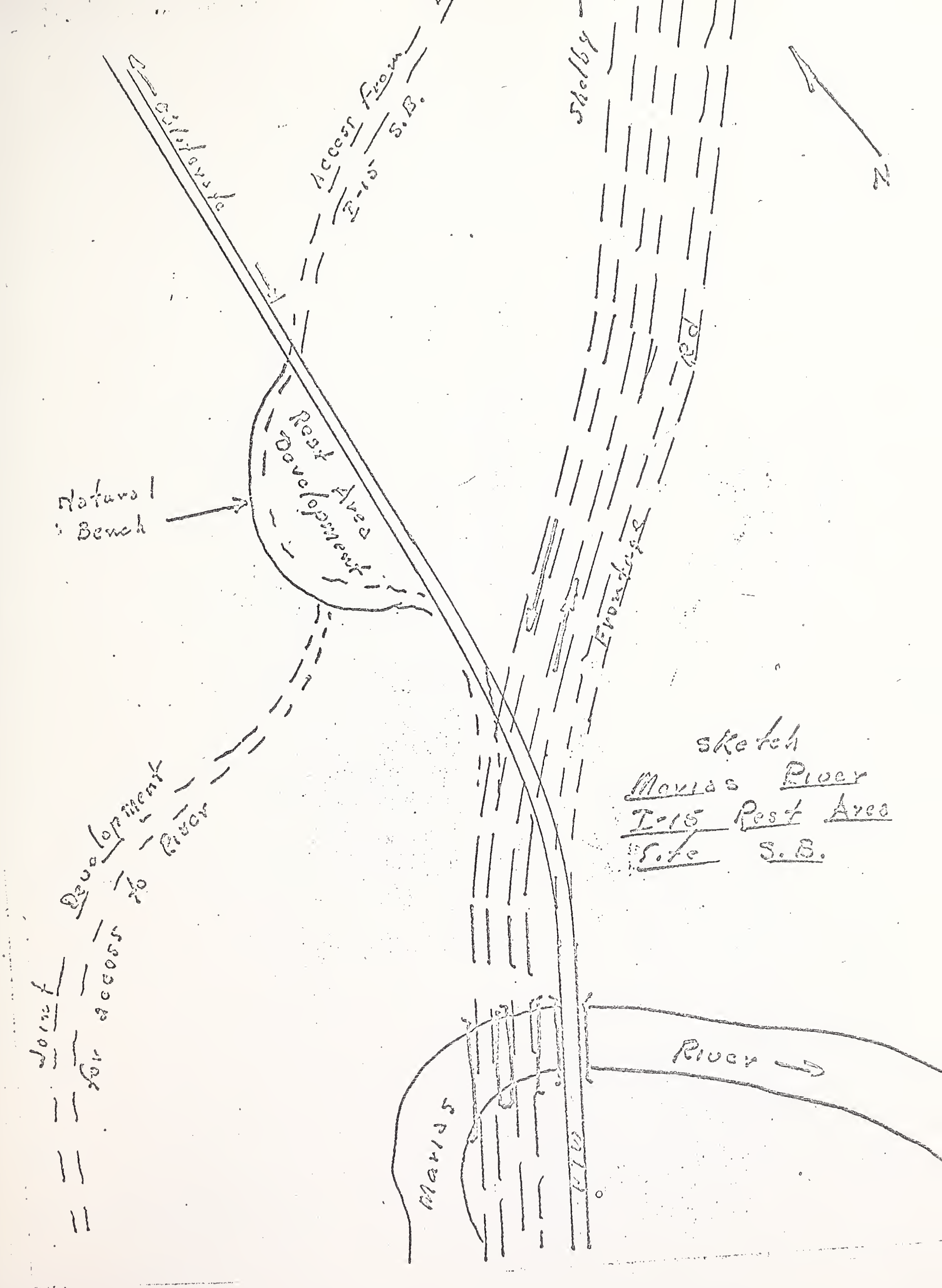
This would be the most difficult and perhaps the most costly to develop.

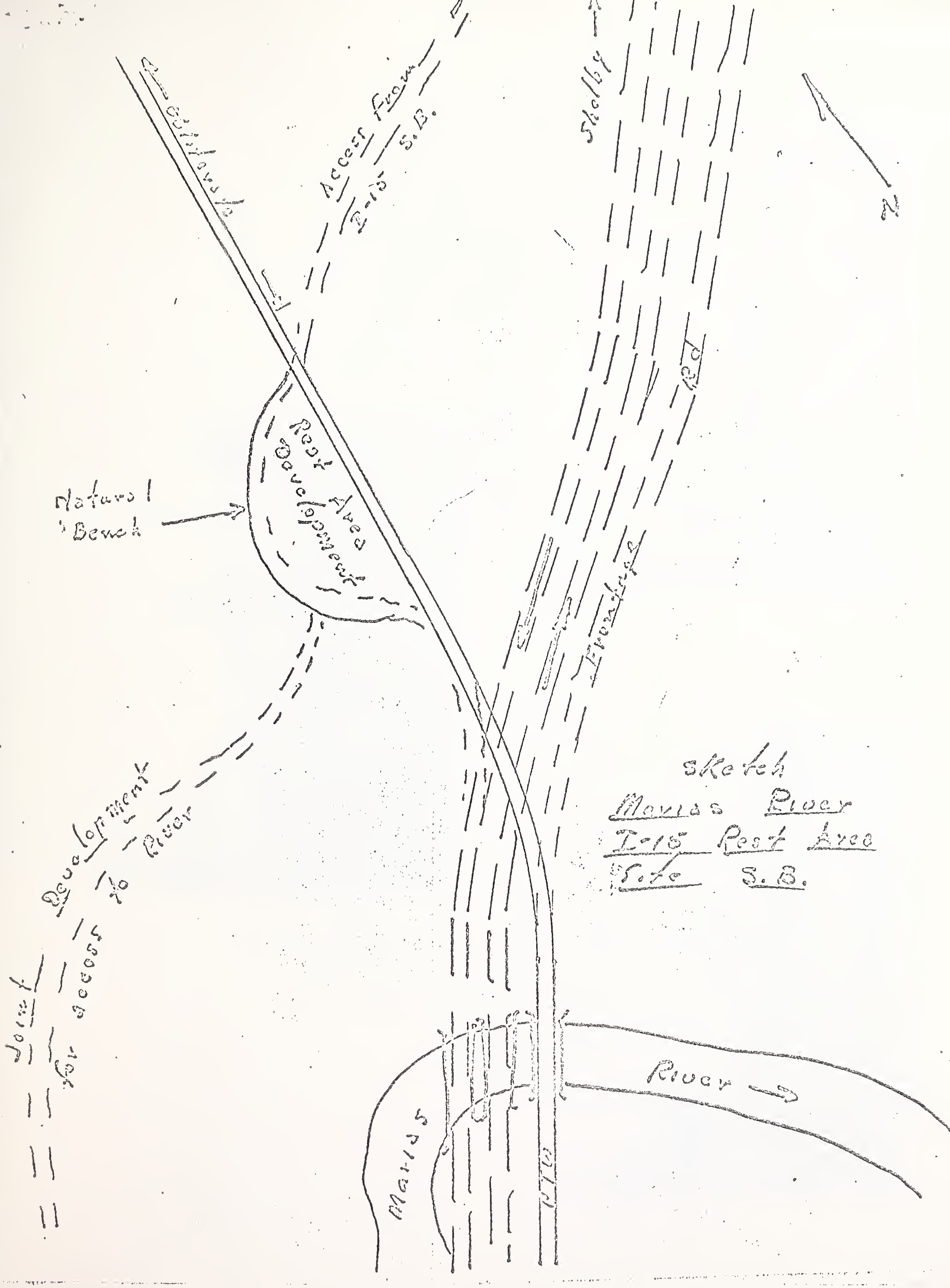
Unfortunately, these sites were studied after the roadway design had been finalized. It would have been far better to have studied these sites before final design stage. Nevertheless, this type of field review should be done more often to clarify many points between the two agencies involved in order that they may work toward a better facility for the highway user and benefit adjacent surrounding communities.

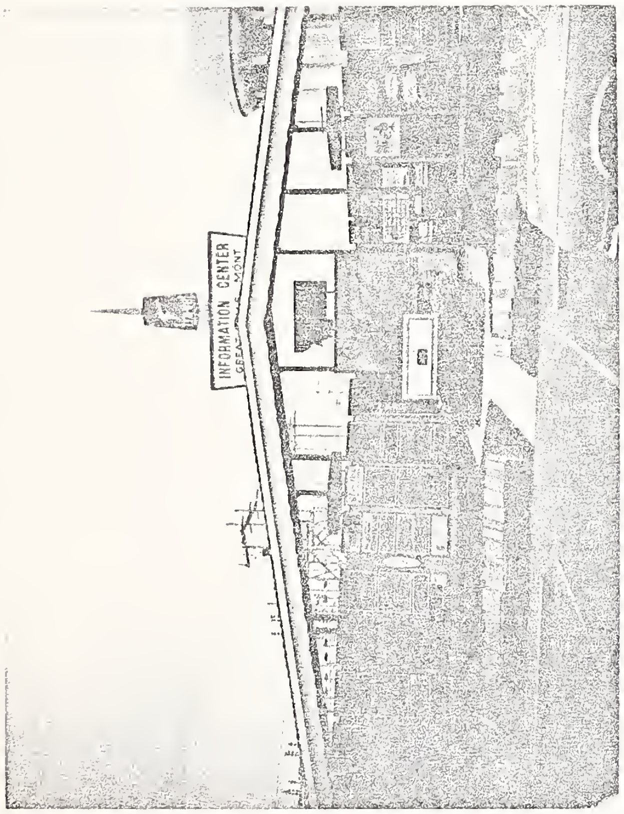


To Shelby
N
RIVER
MARIAS
Existing Pullout
Proposed Rest Area Development
Sketch
Marias River
I-15 Rest Area
Site N.B.


To Shelby
N
RIVER
MARIAS
Existing Pullout
Proposed Rest Area Development
Sketch
Marias River
I-15 Rest Area
S/o N.B.


Access from I-15 S.B.
Shelby
Rest Area Development
Natural Bench
Frontage Rd
Joint Development for access to River
River
Marias
Sketch
Marias River I-15 Rest Area Site S.B.
N


Sketch
Marias River
I-15 Rest Area
Site S.B.
Access From
I-15 S.B.
Shelby
Rd
Frontage
Rest Area
Development
Natural
Bench
Joint Development
for access to River
River
Marias
N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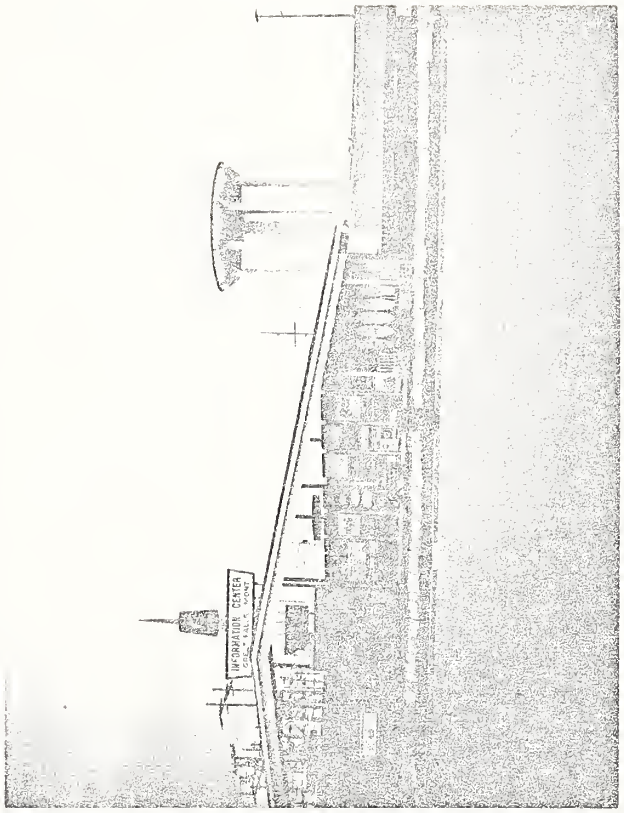
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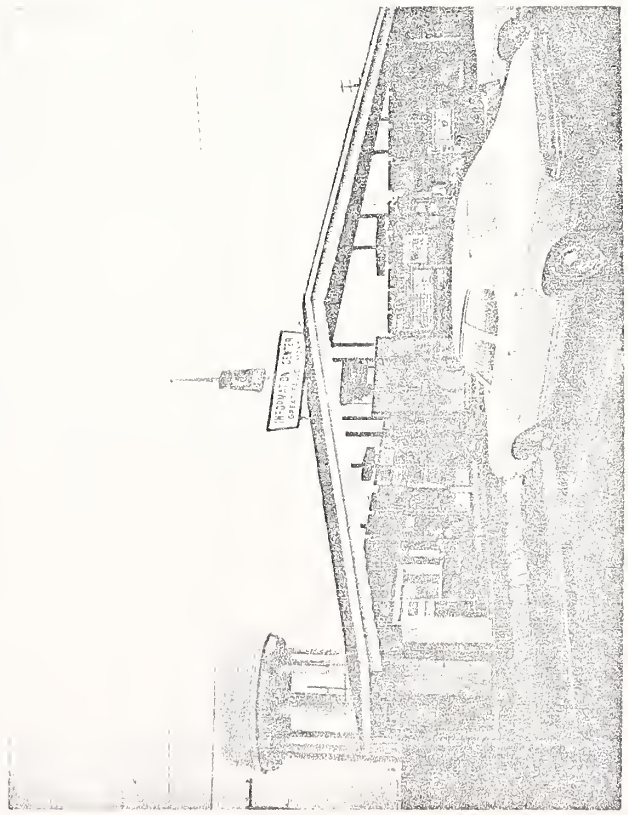
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